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Bibliography of Wind-Wave Data and Publications for the Coastal Regions of Australia

L. J. Hamilton

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Bibliography of Wind-Wave Data and Publications for the Coastal Regions of Australia

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Maritime Operations Division
Aeronautical and Maritime Research Laboratory

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ABSTRACT

Operational sites providing near real-time wind-wave and swell measurements are listed for the coastal waters of Australia, as at February 1996. A representative listing of historical data sites is also provided, with a comprehensive bibliography of papers and reports on wave investigations. An introduction to wave conditions around Australia is included. Real-time high resolution digital data are available from moored wave-rider buoys, mostly non-directional, and from fixed platforms used by the oil and gas industry. A coastal radar provide directional wave spectra in Gulf St. Vincent. Lower resolution near real-time data are available from satellite altimetry and synthetic aperture radar systems, but not usually within about 80 km of the coast. The JINDALEE over the horizon radar experimental array covers the northwest seas of Australia, and is planned to be expanded to cover the area from Geraldton to Cairns. Spot visual observations of sea conditions are made for beach watch and surf reports, from fixed positions such as lighthouses and oil platforms, and from transiting vessels. The Bureau Of Meteorology runs a Wide Area Model (WAM) for deepwater wave prediction, using satellite and ship observations as inputs.

RELEASE LIMITATION

Approved for public release

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Executive Summary

There is a general lack of information on data and publications for wind-waves for Australian waters, with no complete state or national data archive, inventory, or bibliography. Descriptions and analyses of wave conditions around Australia are scattered over a wide range of sometimes obscure publication types, and the existence of many papers is not widely broadcast e.g. contractor client reports. Investigation has revealed a surprisingly large number of publications and data which do not appear in public oceanographic databases. This amounts to a loss of national resources, which can cause duplication of effort, and frustrating delays in searches for information.

To alleviate the lack of easily accessible information on wave and swell data, this document presents the following information:

(1) details of currently operational real-time sea-wave data acquisition systems for the coastal waters of Australia (as at the end of February 1996). These include in situ instruments, radar systems, satellite and visual observations.

(2) charts and listings of sites at which wave data are known to have been observed, modelled, or hindcast; with summary data details.

(3) a bibliography of papers and reports dealing with the measurement, description, or forecasting of wave conditions around Australia. Some storm surge and seiche papers are also included in separate listings. A cross-reference of sites and publications is included.

(4) a brief introduction to wave conditions around Australia.

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NOTE THAT A LISTING IN THIS DOCUMENT FOR DATA OR REPORTS DOES NOT NECESSARILY MEAN THAT THE DATA OR REPORTS ARE AVAILABLE FOR PUBLIC USE OR PERUSAL, OR THAT DATA OR REPORTS ARE FREE OF CHARGE. REQUESTS FOR DATA OR INFORMATION SHOULD NOT BE MADE TO DSTO, BUT DIRECTLY TO THE ORGANISATIONS WHICH GATHERED THE DATA.

NOTE: If you have data information or reports that could be listed in this document, please send details to the author at Aeronautical and Maritime Research Laboratory, DSTO, P.O. Box 44, Pyrmont, NSW 2009, AUSTRALIA (preferably on a DOS diskette in ASCII or WORD for Windows format; or email ASCII text to les.hamilton@dsto.defence.gov.au).

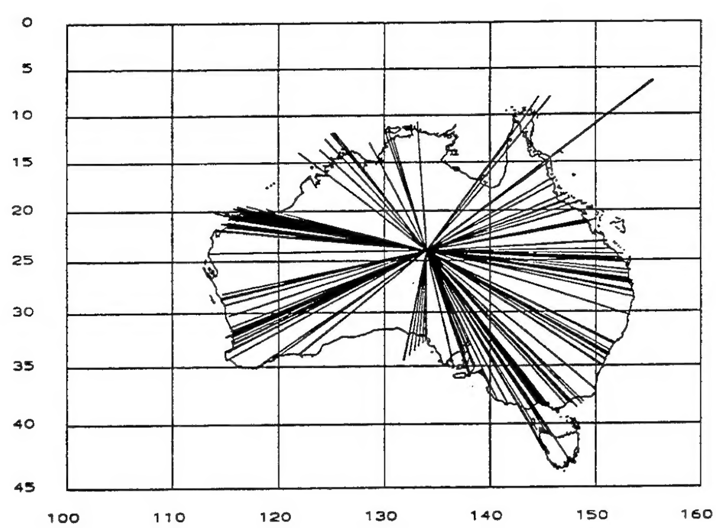

FIGURE: the radials from the centre of Australia point to coastal sites having sea-wave data instrumentally measured *in situ* for which latitudes and longitudes are known. Other instrumental sites are named in the report, but exact positions were not obtained. Many other sites have wave information from visual observation programmes, wave refraction diagrammes, and models.

INDEX

NOTE: Figure and table numbers are the same as the section of text which first refers to them e.g. Fig 1.1.2 is first mentioned in section 1.1.2.

1. INTRODUCTION

1.1 Real-Time Data

1.1.1 Forecasts and hindcasts of wave height and period, and general sea conditions or sea state, are used for recreational, engineering, commercial, harbour safety, and defence purposes. Examples include surfing and boating, beach erosion prevention, siting or design of ocean structures such as oil platforms, keel clearance programmes, and ship routing. Sections 2 to 4 of this document lists sites from which real-time or near-real time wave data are available for the coastal waters of Australia, and briefly describe wave forecast services provided by the Bureau Of Meteorology.

1.1.2 General locations of real-time instrumentation systems are shown in Fig 1.1.2. The Queensland and New South Wales coasts are generally well covered by a network of waverider buoys; Bass Strait by a wavestaff and recorder on Kingfish B oil platform; Port Phillip Bay (Victoria) by three wave-rider buoys; Gulf of St. Vincent (South Australia) by a coastal High Frequency radar; Fremantle (South Western Australia) by three waverider sites and a wavestaff; Geraldton by a waverider; and the North West Shelf (North Western Australia) by instruments on oil and gas platforms and several waveriders off Dampier and Port Hedland. A large part of the south Australian coast from Bunbury to Tasmania has no real-time coverage, however a wave forecast model (WAMDI) run by the Bureau Of Meteorology can provide some information for these areas. No real-time systems are known to exist for Northern Australia from the North West Shelf to Weipa. A wave recorder on Jabiru oil platform may become operational again in the near future (Stuart Anderson DSTO, private communication), and a prototype waverider system is planned off Darwin for May 1996. The JINDALEE over the horizon radar covers the northwestern areas, and it is planned to extend the system to cover all the north from Geraldton to Cairns.

1.1.3 Real-time wave measuring systems are increasingly being used as part of keel clearance systems for ports, and for ship handling and port safety programmes, and more systems are expected to come into use around Australia. For example the Port Of Portland Authority in Victoria are planning to reinstall a system. At least nine long term or permanent systems were installed round Australia during preparation of this report, with three in the Great Barrier Reef lagoon, three wave poles off Fremantle, and one each at Bribie Island, Bunbury, and Dampier. Another wave pole is planned for Port Hedland 1996. Rumours have been received of a planned real-time system to be moored on Gascoyne Seamount (near 36.5°S, 156.5°E), but no details have come to light.

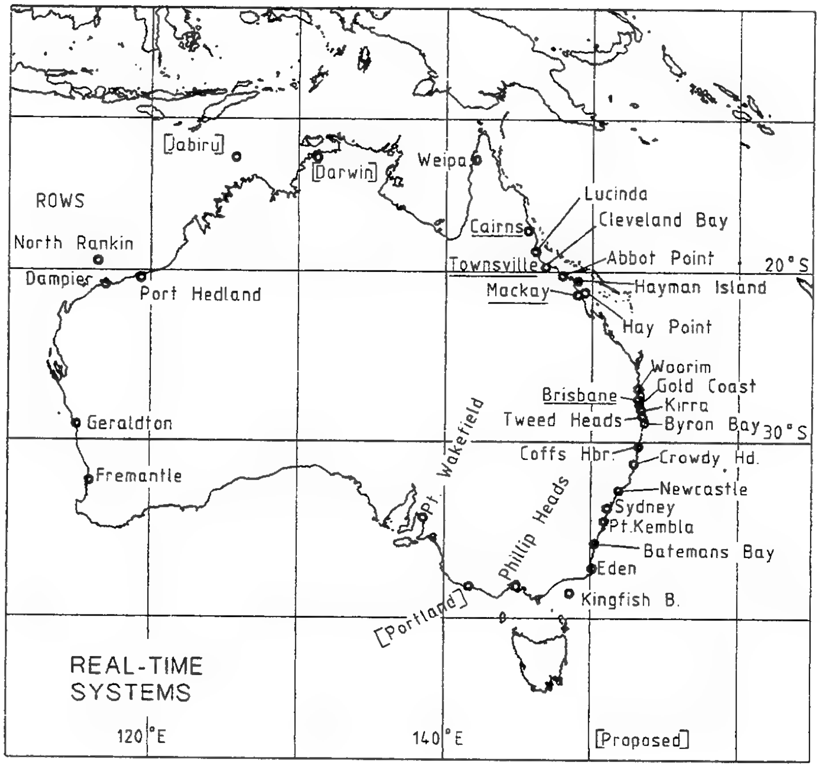

Fig. 1.1.2a. Real-time instrumented sea wave measurement sites around Australia in 1995. [] = proposed site. See Fig 1.1.2b for the positions of the ROWS buoys on the North West shelf, and Fig. 3.1.3 for three sites planned to become operational in the northern Great Barrier Reef lagoon from December 1995.

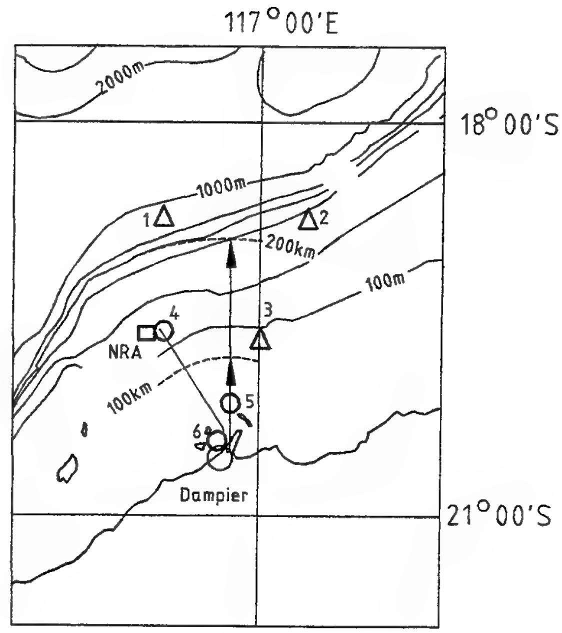

Fig. 1.1.2b. ROWS (Remote Offshore Warning System) of six waveriders on the North West Shelf run by Weathernews Inc for Woodside Petroleum Limited.

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1.2 Historical Data

1.2.2 Many areas do not have real-time systems, and for them the wave climate can be assessed from historical data, by construction of wave propagation models, or by hindcasting using wind data. Models are in need of measured data to enable them to be tuned to local conditions. Brief details of historical wave data are listed in sections 5 and 6 (see Figs 1.2.2a and 1.2.2b for selected locations), but the list is by no means exhaustive. Public archives of wave data do not presently exist in all states, and contractors employed by oil and other commercial companies for environmental studies have not generally made details of their data holdings available. A notable exception is the listing of sites provided by Buchan and Stroud (1993) for the North West Shelf. Much of the oceanographic data collected by the oil and gas industry for the North West Shelf and elsewhere have not entered the public domain. In a major addition to public knowledge of contractor holdings, a list of wave measurement positions were made available to the author by WNI Science and Engineering (a division of Weathernews Pty Ltd), and Lawson and Treloar Pty Ltd, for inclusion in this report (see section 6).

1.2.2 Organisations such as the Beach Protection Authority of Queensland and the New South Wales Public Works and Services Department regularly publish details of their data holdings in annual reports or publication lists, but this does not seem to have been done by other states. Additional details for New South Wales have been made available by the Sydney Ports Corporation. The Port Of Melbourne Authority provided details of real-time systems and listings of waverider data for Port Phillip Bay. Details for southwest Australia were initially obtained by the Australian Oceanographic Data Centre from Grant Ryan of the Department Of Transport. Buchan and Stroud (1993) provide details of selected wave data for the North West Shelf.

1.2.1 **A wave data catalogue was published in 1979 by the Marine Information and Advisory Service of the United Kingdom under the title "Instrumentally Measured Wave Data. Issue 1", and a second edition was released in 1982.** In December 1995 Dr David Neave of the British Oceanographic Data Centre advised that the MIAS catalogue has not been regularly updated. Work has been done on placing the information into an ORACLE database system, and some work done in producing a rudimentary PC based wave catalogue. Some Australian organisations are still reporting data information to the BODC, but no national collation of Australian data holdings appears to have been attempted since the 1982 edition of the MIAS catalogue. Updating of the Australian entries in the MIAS catalogue is not the function of this report, which aims to provide a summary listing only. The activities of the Ocean Rescue 2000 programme may stimulate more activity in providing additional sources and details of archived data. See e.g. the "Blue Pages" on the internet.

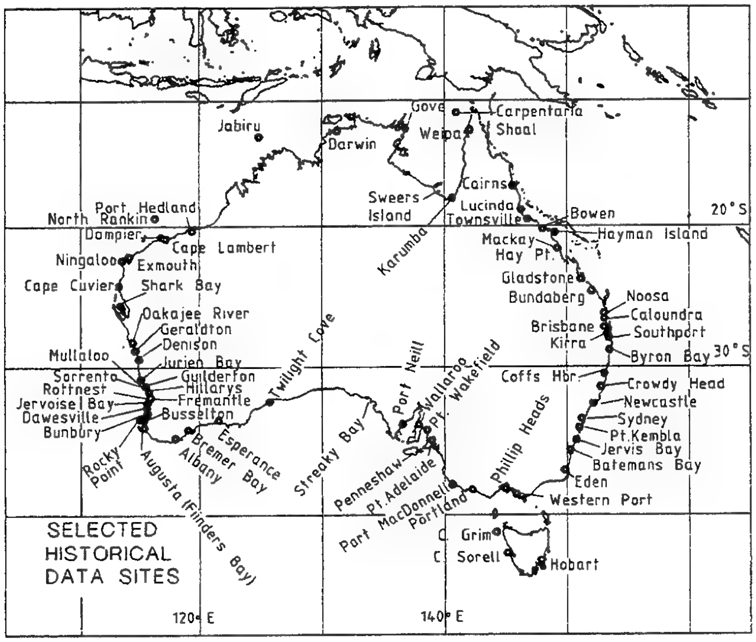


Fig. 1.2.2a. Names of selected sites around Australia as of 1995 where sea wave data have been measured, modelled, or hindcast.

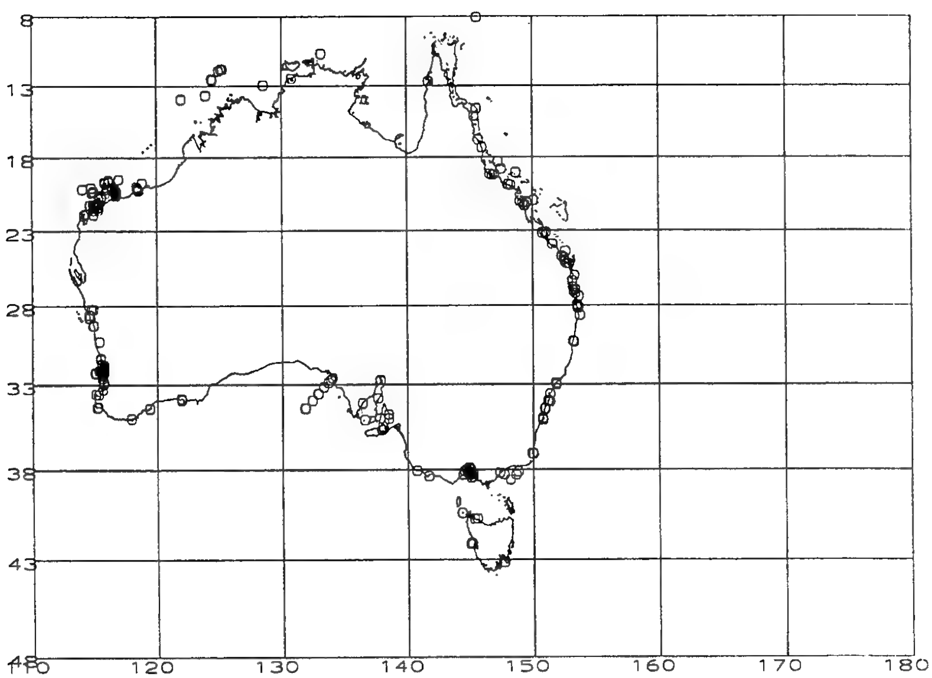


Fig. 1.2.2b. Sites of instrumentally measured wave data for which details are listed in this report.

1.3 Structure of this report

1.3.3 The report consists of the following sections:

1. This introduction
2. Types of real-time wave data (definitions)
3. High-resolution real-time wave data locations
4. Lower-resolution real-time wave data locations
5. Historical wave data locations by state

6.1 Historical wave data locations (WNI Science & Engineering)
6.2 Historical wave data locations (Lawson & Treloar Pty Ltd)
7. Published papers and reports on sea and swell around Australia

APPENDIX I. Cross-References.
Appendix I.A Locations And Papers
Appendix I.B Storm Surges
Appendix I.C Seiching
Appendix I.D Wave models for specific sites
Appendix II. Institutions named in this report
Appendix III. List of Australian and Australasian Conferences on Coastal and Ocean Engineering
Appendix IV. General sea conditions around Australia

Note that a listing in this document for data or reports does not necessarily mean that the data or reports are available for public use or perusal, or that data or reports are free of charge. Requests for data or information should not be made to DSTO, but directly to the organisations which gathered the data.

2. TYPES OF REAL-TIME WAVE DATA

Three types of real-time wave data are defined for this report: (1) high resolution measured data, (2) lower resolution measured data, (3) forecast and modelled data. This document is primarily concerned with measured data, and deals only briefly with type (3).

2.1 High Resolution Measured Data

High resolution data are defined to be digital data obtained directly by wave-rider buoy, wave-staff, pressure recorder, or other *in situ* instrument with high sampling rate and temporal and spatial resolution e.g. particular types of electromagnetic current meters can provide information on wave direction, period, and orbital velocity.

2.2 Lower Resolution Measured Data

Lower resolution measured data are generally provided by remote sensing techniques. Remote sensing includes visual observations, photography, satellite imagery at visible wavelengths, satellite borne altimeters and synthetic aperture radars, and systems such as the JINDALEE over the horizon radar (OTHR) array. Coastal HF and VHF radar systems provide data on smaller spatial scales (HF out to 30 km and VHF out to 2 km from the coast). Surf reports or beach watch reports are made daily for some sites, usually for radio station broadcasts to a local area, and for publication in newspapers. Visual observations made by shipping, and from lighthouses and oil platforms, are reported to the Bureau Of Meteorology in Melbourne, and are made available over various networks.

2.2.1 Satellite Data

Satellite data can provide broad area coverage, unlike the spot coverage of a waverider buoy, but do not have the accuracy of most *in situ* systems. Information are available from altimetry, synthetic aperture radars (SARs), and visible wavelength imagery. Near coastal data are likely to be corrupted by signatures from land, especially when crossing from land to sea. Altimetry provides wave heights and wind speeds, while synthetic aperture radar in principle gives the full wave directional spectrum. Much of the following information on altimetry and SARs is taken from the article "Wave-Climate Assessment By Satellite Remote Sensing" by Dr. Stephen F. Barstow and Dr. Harald E. Krogstad in Sea Technology, October 1995, Volume 36, No. 10, pp31-38.

2.1.1.1 Altimetry

Satellite altimetry provides information on wave height and wind speed. The application is for deep sea rather than coastal waters. "Significant wave height is determined from the shape of the return pulse of the radar altimeter. A calm sea with low waves returns a condensed pulse, whereas a rough sea with high waves returns a stretched pulse. .... In general there is a high degree of correlation between wind speed and wave height" (Jet Propulsion Laboratory and NASA information USA). Altimeters give an estimate of wave height, but not wave period, and this must be modelled from the wind field. Wind speed may be derived from the strength of the returned signal which varies with the amount of short wind waves on the surface. Altimeter systems are generally more reliable for higher wave heights, with altimeter accuracy quoted as ±0.5 m or perhaps 10%. Spatial resolution is limited to about 7 km along track.

2.2.1.2 Synthetic Aperture Radar (SAR)

Synthetic aperture radar in principle gives the full directional wave spectrum. A major advantage over other satellite sensors is that SAR can operate unaffected by atmospheric (weather) conditions. Processing is complicated and produces a spectrum with 180° ambiguity. SAR data are most useful for long period swells, with observations limited to waves longer than about 40 m. Images of the sea surface are typically produced with about 10-20 m resolution, for an area covering 100x100 kilometres. For the ERS-1 satellite the present upper frequency limit is about 0.125 Hz in deep water and less in shallow water. Spectra are recorded about every 200 km along track.

2.2.1.3 Visible Imagery

Data obtained at visible wavelengths e.g. aerial photography, or LANDSAT satellite data, can sometimes provide good estimates of wave propagation direction, wave-length of the dominant swell, and wave-number spectra.

2.3 Forecast and modelled data

2.3.1 Synoptic Forecast Services

2.3.1.1 A limited description of Bureau Of Meteorology (BOM) services provided for coastal waters may be found in *Winds, Waves, Weather* boating series booklets available for purchase from the BOM. Booklets are available for Victorian waters, New South Wales waters, Perth waters, and a booklet for South Australia was being prepared (see Bureau Of Meteorology Annual Report 1993-94, AGPS Canberra). An earlier description of types of forecasts made by the BOM is given by Gaffney et al (1979). They describe services such as gale and storm warnings, coastal waters bulletins, and tropical cyclone warnings, and show charts of the areas covered by these services. These services are broadcast regularly over television and radio services and marine radio bands. Some of the available services are shown in Fig 2.3.1a-d. Forecasts for conditions in coastal waters are available for all states e.g. by **fax** (Fig 2.3.1.1a, Fig 2.3.1.3b). Coastal weather and maritime forecasts are also available on the **Internet** e.g. Fig 2.3.1c and Fig 2.3.1d [from gopher://babel.ho.BOM.GOV.AU].

Fax Weather Services from the Bureau of Meteorology

To obtain the products below put your fax in poll receive mode and dial the product number. A detailed directory & explanation of services is on 019 725 200

Satellite Pictures Updated Hourly

Australia	019 725 201
NE Australia	" " 202
SE Australia	" " 203
W Australia	" " 204
S Australia	" " 205

Charts

Weather Chart	019 725 210
Forecast Chart	" " 211
Swell Forecasts	" " 266

Canberra Forecast 019 725 260

Cost approx 55 cents per minute

For a free directory of Infofax services poll 1800 808 096

Forecast Services Include

Queensland	
Coastal Waters	019 725 270
Rural Regions	" " 271
Brisbane & State	" " 272
New South Wales	
Coastal Waters	019 725 220
Rural Regions	" " 221
Sydney	" " 222
Victoria	
Coastal Waters	019 725 230
Rural Regions	" " 231
Melb Bays & State	" " 232
Tasmania	
Coastal Waters	019 725 240
Rural Regions	" " 241
Cities & State	" " 242
South Australia	
Coastal Waters	019 725 280
Rural Regions	" " 281
Adelaide & State	" " 282
Western Australia	
Coastal Waters	019 725 290
Rural Regions	" " 291
Perth & State	" " 292

Cost approx 55 cents per minute

Fig 2.3.1.1a. Phone numbers for FAX weather services from the Bureau of Meteorology (BOM).

Ocean Forecasts and Charts

---

019 725 266 Swell Forecast Charts (+24 & +36 hours) - deep water swell wave height forecasts for 24 hours and 36 hours. Contours show swell heights in metres and arrows show direction of highest swells. Forecasts valid for 0000 UTC and 1200 UTC, issued twice a day at about 0400 and 1600 UTC. Receive time 2 pages - about 2'15"

019 725 267 High Seas NE Forecast - 24 hour forecast extending over ocean waters from the Equator to 28 degrees South and 142 to 170 degrees East. The forecast is made up of 3 parts: Part 1 - Warnings, Part 2 - Situation (a description of the synoptic pattern), and Part 3 - Forecast. Issued at 2300 & 0800 UTC. Receive time - about 0'45"

019 725 268 High Seas SE Forecast - 24 hour forecast extending over ocean waters from 28 to 50 degrees South and 129 to 170 degrees East. Issued at 0845 and 2245 UTC. Receive time - about 0'45"

019 725 264 SE Australia Sea Surface Isotherms - charts of weekly sea surface temperature in degrees celsius covering the area from Port Macquarie to Lakes Entrance. Updated Wednesday 5pm. Receive time - about 1'00"

019 725 265 SW Australia Sea Surface Isotherms - charts of weekly sea surface temperature in degrees celsius covering the area from Shark Bay to Albany. Updated Wednesday 5pm. Receive time - about 1'00"

019 725 269 Darwin Weekly Sea Surface Temperatures - charts of weekly sea surface temperature in degrees celsius covering the area from 40S to 40N and 70E to 180E. Receive time - about 1'00"

019 725 352 Global Weekly Sea Surface Temperatures - charts of weekly sea surface temperature in degrees celsius. Receive time - about 1'00"

019 725 475 Forecast Sea Surface Winds for Eastern Australia (+12, +24 & +36 hours) - the Marine Boundary Layer (MARBL) wind forecasts are based on the Bureau's Australian Region prediction model (called RASP). The product is for general guidance and should be used in conjunction with the appropriate Coastal Waters or High Seas Forecasts and Warnings. The forecast winds are based on the Bureau's 0000 UTC and 1200 UTC runs of the RASP model and are valid for +12, +24 and +36 hours. They are available at approximately 0500 UTC (1500 EST) and 1600 UTC (0200 EST). Receive time - about 4'00"

New South Wales - Forecasts and Reports

(NB: during daylight saving replace EST by Summer Time)

019 725 220 Coastal Waters - forecasts, warnings and 3 hourly weather reports - forecasts available at about 0230, 1130 and 1630 EST. Coastal weather reports taken at 0300, 0600, 0900, 1200, 1500, 1800 & 2100 EST, are available about 30 minutes after observation time. Receive time 2 pages - about 1'30"

Fig 2.3.1.1b. Brief description of some of the FAX weather services listed in Fig 2.3.1.1a. (Obtained from the BOM internet site).

```
NSW Coastal Waters Forecast
Bureau Meteorology, Sydney
Issued at 0450 hours on  Thursday, 25/01/96
Valid until midnight Thursday

Situation 0300 EDST Thursday
High pressure system in southern Tasman Sea.  Front approaching south
coast, expected on NSW central coast this morning and the mid north
coast later this afternoon.

Warnings:
Strong wind south of Seal Rocks.

Weather:
Showers and storms clearing behind the change.

Swell:
1.5 to 2 metres increasing later today to 2.5 to 3.5 metres in the
south.

Far North Coastal Waters:
Qld/NSW border to Wooli and 60nm seaward
N/NE winds 10/15 knots increasing to 15/20 knots in afternoon and
evening.
Seas 1 to 2 metres.
Outlook Friday... Winds tending W/SW 10/15 knots

Mid North Coastal Waters:
Wooli to Seal Rocks and 60nm seaward
N/NE winds 10/20 knots freshening 15/25 knots Thursday, then turning
SW 15 knots  late Thursday
Seas 1 to 2 metres
Outlook Friday... Winds tending NW/NE 10/15 knots

Hunter Coastal Waters:
Seal Rocks to Broken Bay and 60nm seaward
NW/NE winds 20/30 knots ahead of a W/SW change 20/25 knots around
midday and easing to 15 knots by Thursday evening.
Seas 2 to 3 metres abating in afternoon
Outlook Friday... Winds tending N/NE 10/20 knots

Sydney Coastal Waters:
Broken Bay to Port Hacking and 60nm seaward
NW/NE winds freshening to 20/30 knots ahead of a W/SW change 20/25
knots later this morning. Winds easing to 15 knots this afternoon.
Seas 2 to 3 metres abating this afternoon.
Outlook Friday... Winds tending NW/NE 10/20 knots

Sydney Closed Waters:
Pittwater, Port Jackson and Botany Bay
NW winds 20/25 knots ahead of a W/SW change 20/25 knots later this
morning. Winds easing to 15 knots this afternoon.
Waters choppy to rough.
Outlook Friday... Winds tending NW/NE 10/20 knots

Illawarra Coastal Waters:
Port Hacking to Ulladulla and 60nm seward
N/NW winds 20/30 knots ahead of a W/SW 20/30 this morning.
Winds easing to 15/20 knots by this afternoon.
Seas 2 to 3 metres abating later.
Outlook Friday... Winds tending N/NE 10/20 knots

South Coastal Waters:
Ulladalla to Gabo Island and 60nm seward
NW/NE winds 20/30 knots, ahead of a gusty W/SW change early this
morning. Winds easing to 15/20 knots later this afternoon.
Seas 2 to 3 metres abating later
Outlook Friday... Winds tending N/NE 15/20 knots
```

Fig 2.3.1.1c. Example of a coastal waters forecast available by FAX, Internet, or voice message from the BOM. New South Wales coastal waters forecast. (Obtained from the BOM internet site).

Maritime forecast for NSW issued by the Bureau of Meteorology, Sydney
at 1855 on TUESDAY, 23/01/1996 for WEDNESDAY, 24/01/1996

TASMAN SEA 28 AND 38 DEGREES SOUTH AND WEST OF 160 DEGREES EAST:
Winds easterly 10 to 20 knots tending northeasterly and strengthening
to 30 knots in the southeast.
Seas 1 to 1.5 metres becoming 1.5 to 2 metres in the south, on a
1 to 2 metre swell.

NSW COASTAL WATERS:
Winds E'ly 10/15 knots in north, grading to 15/25 knots in the south.
Seas 1 metre north rising to 2 to 3 metres in south, on a 1 to 2
metre swell.

SYDNEY WATERS:
Winds E'ly 15/25 knots turning NE. Waters choppy at times.

Fig 2.3.1.1d. Example of a New South Wales maritime waters forecast available by FAX, Internet, or voice message from the BOM. (Obtained from the BOM internet site).

2.3.1.2 Australian Forecasts - WAMDI Model

The Bureau Of Meteorology in Melbourne receives ERS satellite wind and altimeter data 4 to 7 hours after orbit from a satellite centre in Europe. There is a 180° ambiguity in wind direction, and 25 km resolution. Best data are obtained for wind speeds of 10-20 knots, with a deterioration with increasing wind speed. The data are input to a Wide Area Model (WAM) to produce a wave spectrum having 24 directions, and 12 frequency bands. There is no pre-defined spectral shape. Energy spectra are predicted from wind stress input, with allowances for group velocity, energy dissipation, non-linear wave interactions, and propagation, refraction, and shoaling effects. Only deep water waves are predicted, in 3°x3° or 1°x1° bins, except for Bass Strait where 0.25°x0.25° bins with high resolution bathymetry are used. The deep water model is verified by shallow water waverider buoy data, but shallow water effects are not allowed for. Wave data are input from a waverider network along the New South Wales coast (e.g. Byron Bay, Botany Bay), from Kingfish B platform in Bass Strait, and North Rankin on the northwest shelf. Accuracy is estimated at about 1 metre. *Model outputs are available by FAX, modem, and Internet* (an example is shown in Fig 2.3.1.2). The following references can be consulted for further theoretical details: 1. Bender L.C. and Leslie L.M. (1994). Evaluation of a third generation wave model for the Australian region. BMRC Research Report No. 43. (Bureau Of Meteorology Research Centre - available only on personal application for purposes of research). 2. WAMDI Group (1988). The WAM model - a third generation ocean wave prediction model. Journal Of Physical Oceanography 18, 1775-1810. (Information from a seminar by G. Warren at BOM in Sydney 1995). The WAM model applies to water depths greater than 20 m (Huppert 1991).

Understanding the Swell Forecast Charts

These charts, which provide swell height and direction forecasts for 24 hours and 36 hours, are supplied directly from computer models. The contours show expected deep water swell heights (the significant height not the maximum height) in metres, while the arrows show the forecast direction of movement of the dominant swell. A note of caution - the forecast swell heights are not applicable to beaches, reefs or shallow waters where wave breaking occurs. In shallow waters swell heights may increase considerably just prior to wave breaking.

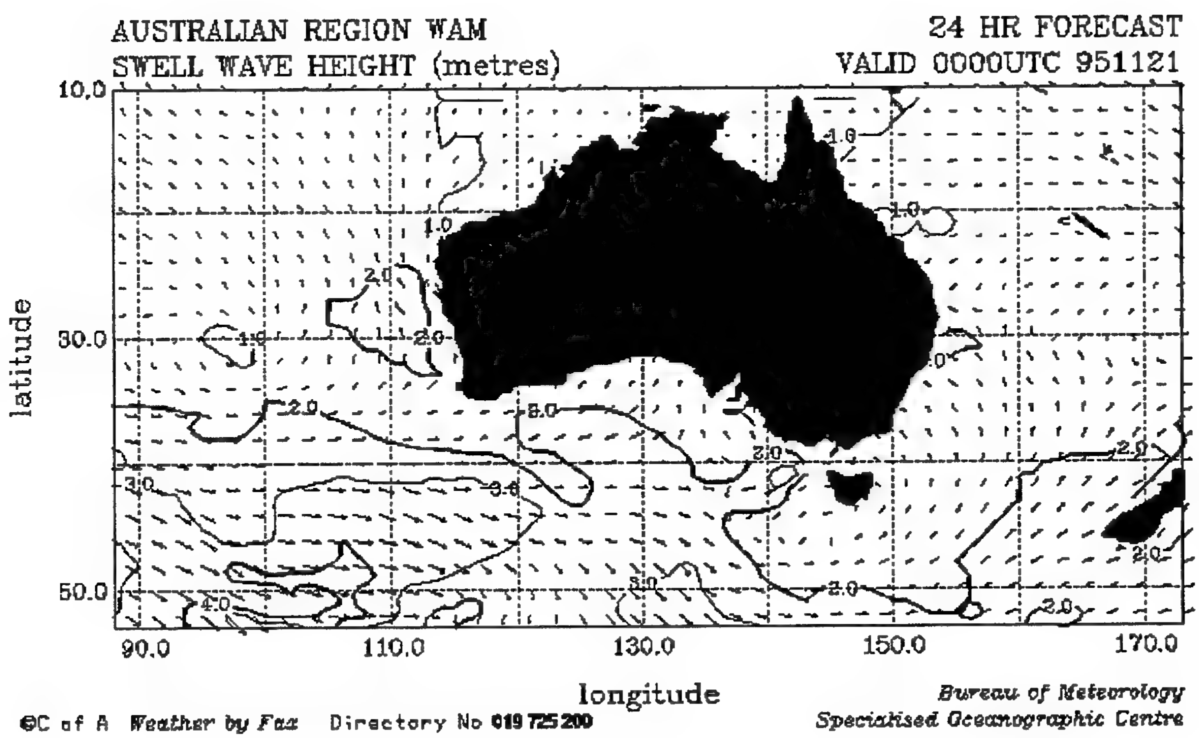


Fig. 2.3.1.2. Example of near real-time wave height chart for Australian waters derived by the Bureau Of Meteorology using the WAMDI model. Available by FAX and Internet.

2.3.1.3 Wave Model (WAM). A worldwide waves forecast produced by the United States Navy Fleet Numerical meteorology and Oceanography Center (FNMOC) in Monterey, California, USA using a WAM model on a 1° grid is produced as a colour chart available over the Internet [http://www.fnoc.navy.mil/wam.html] (Fig 2.3.1.3). This product is not specifically tuned to Australian conditions, but being independent of WAMDI (see section 2.3.1.2), could be used for comparison purposes and general indications of Australian swell conditions.

2.3.1.3.1 "The third-generation Wave Model currently implemented at FNMOC is run on a global 1.0 degree spherical grid with 15 degree angular resolution for the directional spectra, using a 20 minute propagation time step. Surface wind stress fields generated by the Navy Operational Atmospheric Prediction System (NOGAPS) provide the unique ocean atmosphere coupling. The model is run four times per day, producing a 6-hour hindcast followed by a a 72-hour forecast on the 00Z and 12Z ontime runs, and a 6-hour hindcast on the 06Z and 18Z offtime runs to maintain continuity of the model's spectral energy history file".

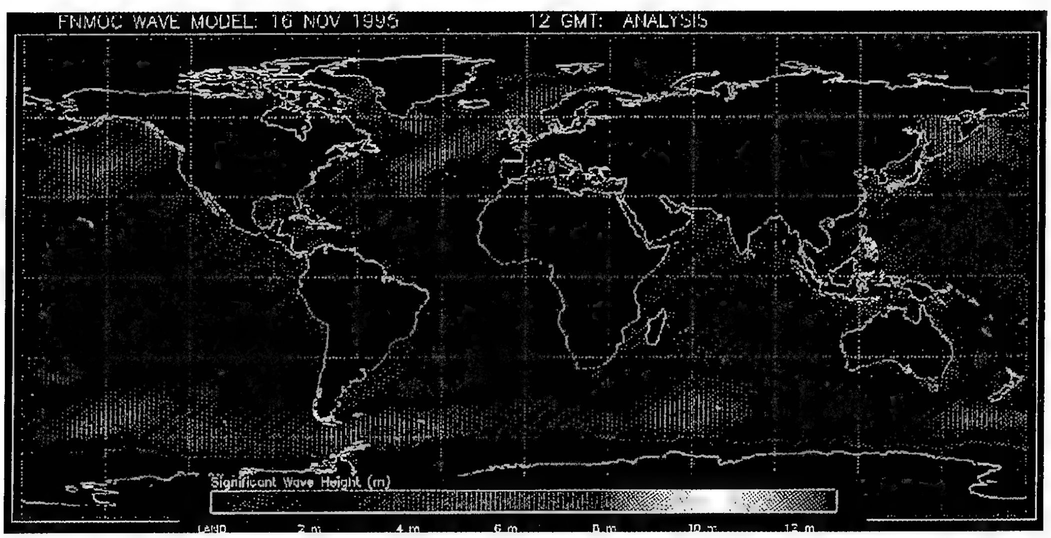


Fig. 2.3.1.3. Example of near real-time wave height chart for the world derived by FNMOC using a WAM model. The chart is available on the Internet [http://www.fnoc.navy.mil/wam.html].

2.3.1.4 Bass Strait Forecasts

"The (Cardone) wave model was installed at the BOM in Melbourne in 1986. The wind model FINEST, which was developed by BOM, supplies wind data to drive the wave model. Calibration, validation and refinement of the wind/wave system was carried out during 1986/87. Rms errors in wave height of down to 0.5 m at a 12 hour forecast are achieved" (Curnow 1987). This system was developed for the Bass Strait oil platforms. An earlier model set up by Oceanographic Services Inc. is described by Silbert et al (1980). As mentioned in section 2.3.1.2 the BOM now uses the WAMDI model on a quarter-degree grid in the Bass Strait area. Huppert (1991) reports an rms wave height error on the west coast of Tasmania of 0.7 m.

2.3.1.5 West Australia Region Forecasts

An earlier manual trial scheme is described by Dexter (1978). Huppert (1991) describes a regional numerical forecast system, partly based on the WAMDI wave model, made to study and predict storm surges and surface waves resulting from tropical cyclones. The Special Services Unit of the Bureau of Meteorology Regional Office in Perth advises that no separate wave forecast scheme has been set up for the West Australia area (as at October 1995). WNI Science and Engineering have a wave forecast system for the northwest shelf with links to Perth (see section 3.7).

2.3.1.6 Global Forecasts

The Oceanweather Global forecast is available on the internet at http://www.oceanweather.com . Another global product is available on the internet at http://polar.wwb.noaa.gov/waves/. For FNMOC see section 2.3.1.3.

2.3.1.7 Surf forecasts on the Internet

Several web sites and links are available, some with location maps and photographs of wave conditions.
See e.g. http://www.ozemail.com.au/~michaelt/surf.htm, and
http://www.surfcams.com/index_oz.htm .

3. HIGH RESOLUTION REAL-TIME WAVE DATA LOCATIONS

Sites from which real-time high-resolution data are available are shown on charts (see e.g. Fig 1.1.2), and listed in Tables. The charts start at Queensland, and move clockwise round Australia in the order Queensland, New South Wales, Victoria (including Bass Strait), Tasmania, South Australia, southwest Australia, northwest Australia, north Australia in general, and the Northern Territory. Data for some sites may not be routinely available e.g from oil and gas platforms, and from port and harbour authorities. Data are non-directional unless specified otherwise. Several organisations also regularly obtain visual observations of wave direction to enhance the wave height data collected by non-directional waverider buoys. Some details of visual observations are given in section 4 for lower resolution real-time data.

3.1 Queensland

Two organizations are known to have near real-time wave measuring systems, the Beach Protection Authority (BPA) and James Cook University Department of Civil and Systems Engineering. The Beach Protection Authority run systems from Weipa to Brisbane, and James Cook University plan to have three offshore sites in the Great Barrier Reef lagoon.

3.1.1 General Background Information - Beach Protection Authority

3.1.1.1 Occasional annual reports of the **Beach Protection Authority Queensland** to 1989 provided lists of current and former operational waverider and visual observation sites. "The Beach Protection Authority has been involved in the recording of waves (by waverider buoys) at various locations along the Queensland coast since 1968. The Authority operates five long term stations at Cairns, Townsville, Mackay, Burnett Heads {since removed} and Brisbane, each of which has been operating for over 10 years. .... The Authority also establishes short-term wave recording stations when required. Such stations presently are operating at Noosa, Woorim (Bribie Island) and the Gold Coast..." (Beach Protection Authority Queensland, 1989 Annual Report, 52pp). Visual observations of wave direction are potentially available from the COPE programme (described in section 4.2). Limited details of the BPA programme may now be found in Department of Environment and Heritage annual reports.

3.1.1.2 "Established wave recording stations at Cairns, Townsville, Mackay and Brisbane contribute to long-term wave statistics used for coastal management purposes. The station at Burnett Heads was removed due to funding constraints. Short-term wave recording stations are operating at Kirra, Surfers Paradise, Abbot Point, Woorim, Townsville, Hay Point, and Weipa. *All wave recording stations have been upgraded to a new personal computer-based system which features real time access"* (Anon 1994).

3.1.1.3 Allen and Ettema (1993) of the Coastal Management Branch, Department of Environment and Heritage discuss a real-time system by which data is downloaded to a PC in the Brisbane office and to external users. Murray et al (1993) state "The data received from the waverider buoy is analysed on site and is immediately available to the user. This is achieved by using a personal computer in conjunction with the receiver to collect and analyse data immediately and communicate the results by telephone. An increase in recording intervals is triggered when the wave height exceeds a preset threshold value. This allows more data to be collected in periods of heavy weather."

3.1.2 Information For 1995 - Beach Protection Authority

3.1.2.1 As at July 1995 there were 15 BPA wave recording buoys moored off the Queensland coast (Fig 3.1.2). Sites were Abbot Point, Brisbane, Cairns, Gold Coast, Hayman Island, Hay Point, Karumba, Kirra, Lucinda, Mackay, Repulse Bay, Townsville, Tweed Heads, Weipa, and Woorim. Directional buoys were operating at Karumba and Mackay. The buoys at Karumba finished operations in October 1995, and a directional buoy is now operating at Tweed Heads. With the exception of Brisbane, all buoys are in depths of 25 m or less. The BPA also deploys Interocean S4 current meters logging pressure at 2 Hz, from which directional wave spectra may be obtained. This information was supplied by the BPA in November 1995.

3.1.3 Information For 1995/6 - James Cook University

Dr Tom Hardy of **James Cook University Department of Civil and Systems Engineering, Townsville** advises that several wave measuring systems will be deployed progressively from December 1995 in the Great Barrier Reef lagoon. Shallow water stations at Green Island, Norman Reef, and Agincourt No. 3 Reef (Fig 3.1.3) are intended to run for several years, with shorter deployments at other locations. Receivers near the locations on pontoons owned by Quicksilver Greater Ventures will log the data, which will be available on a dial-up basis by telephone. This information was supplied in late November 1995.

3.1.4 Information For 1995/6 - Manly Hydraulics Laboratory

Mark Kulmar of Manly Hydraulics Laboratory advises that two wave poles were installed at Bribie Island in June 1996 for the Port of Brisbane Corporation.

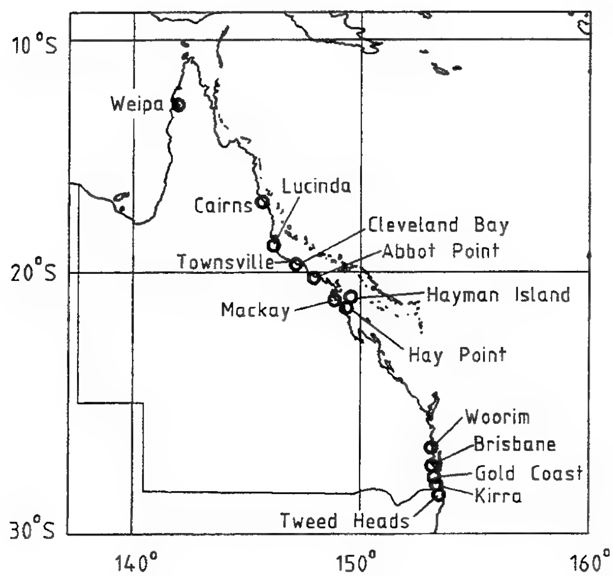


Fig. 3.1.2. Real-time instrumented sea wave measurement sites off Queensland in 1995. Information supplied by the Beach Protection Authority of Queensland. See Fig 3.1.3 for three sites planned to become operational in the northern Great Barrier Reef lagoon from December 1995.

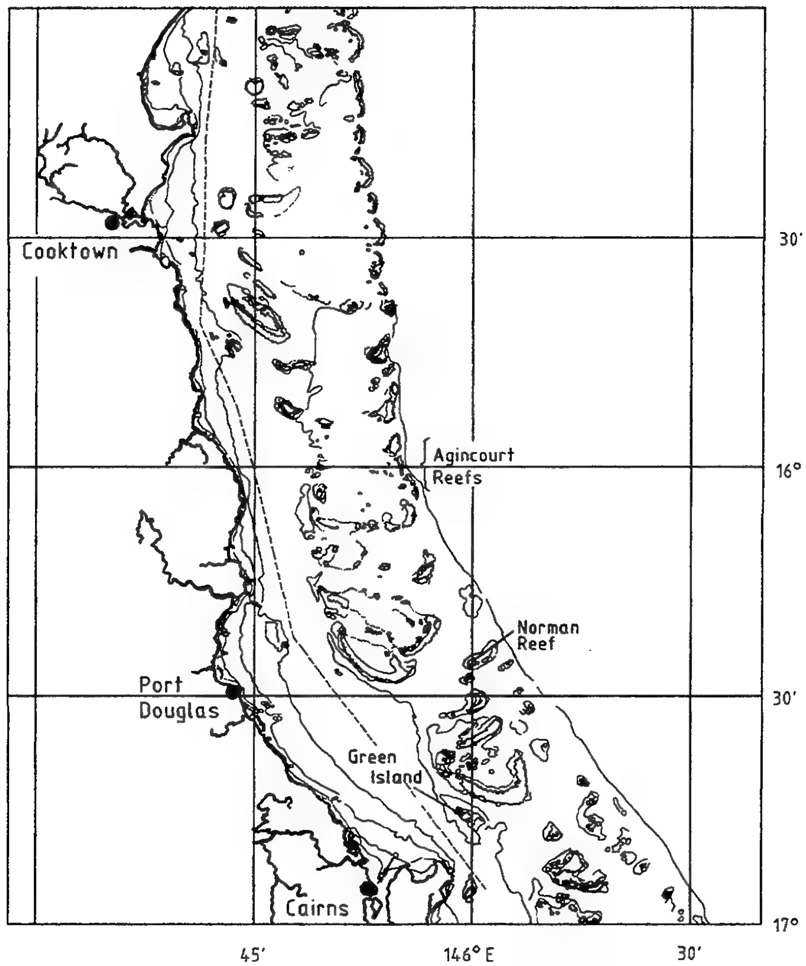


Fig. 3.1.3. Three real-time instrumented sea wave measurement sites off Queensland planned to become operational in the northern Great Barrier Reef lagoon from December 1995. Green Island, Norman Reef, and Agincourt Reef number 3. Information supplied by Dr T. Hardy of James Cook University of North Queensland.

3.2 New South Wales

Three state organisations are known to have independent real-time wave data systems. These are the **Sydney Ports Corporation**, the **Manly Hydraulics Laboratory** of the New South Wales Public Works and Services Department (NSW PWD), and the **Sydney Water Board**.

3.2.1 A schematic of the PWD real-time system is shown in their annual wave climate summaries e.g. PWD (1994). PWD (1992) shows real-time waverider sites at Byron Bay, Coffs Harbour, Crowdy head, Sydney (including a directional waverider), Port Kembla, Batemans Bay, and Eden (see Fig 3.2.1). Information is available in real-time (or near real-time) as part of a **storm-watch system**. Data are gathered hourly and down-loaded either twice per day, or hourly in stormwatch mode. Data from all NSW PWD buoys along the NSW coast are fed into a central computer at the Manly Hydraulics Laboratory, and later stored on optical disc. The data are used for coastal studies projects. **Near real-time data** from the Stormwatch system **can be accessed** by remote terminal linked by modem to Manly Hydraulics Laboratory computer, and **on the internet** at **http://www.mhl.nsw.gov.au/** (PWD 1996). Charts of significant waveheight and period with time are available, updated four times daily. When significant waveheight is more than 3.5 metres, charts are updated 40 minutes after each hour.

3.2.1.1 **Water level data** are sampled at 1 second intervals by PWD tide gauges (Zwarts poles and Floatwell), but most are sited in protected positions which are not representative of offshore wave conditions. In enclosed areas they may also experience boat waves. Sites are shown in Fig 3.2.1.1. [See e.g. N.S.W. ocean tide levels Annual Summary 1994/95. Public Works Department (1995). Manly Hydraulics Laboratory report 732]. Water level data collected at selected Zwarts Pole locations are filtered and analysed to provide long wave statistics. Long waves have periods which range from 30 seconds to several minutes, and are often associated with storm wave activity off the NSW coast (MHL Report 733). Directional wave data are available from sites fitted with Zwarts poles and Marsh-McBirney current meters.

3.2.2 The Sydney Ports Corporation (SPC), a subsidiary of the Maritime Services Board of NSW, runs the **RODIS (Realtime Oceanographic Data Instrumentation Systems) network** (Willoughby 1995). This includes waverider buoys at Botany Bay, Newcastle, and Port Kembla and also tide gauge and anemometer data. Wave data is supplied throughout the SPA and to many of its customers in realtime and is updated every 10 minutes. The application is primarily for safety of port operations. At time of preparation of this report the SPA have not prepared documentation on their real-time system. However Max Willoughby advises there are two waveriders in Botany Bay (one of which is directional), one in deepwater outside the bay, one at the entrance to Port Kembla in 20 m, and two at Newcastle entrance in 20 m (Fig 3.2.2).

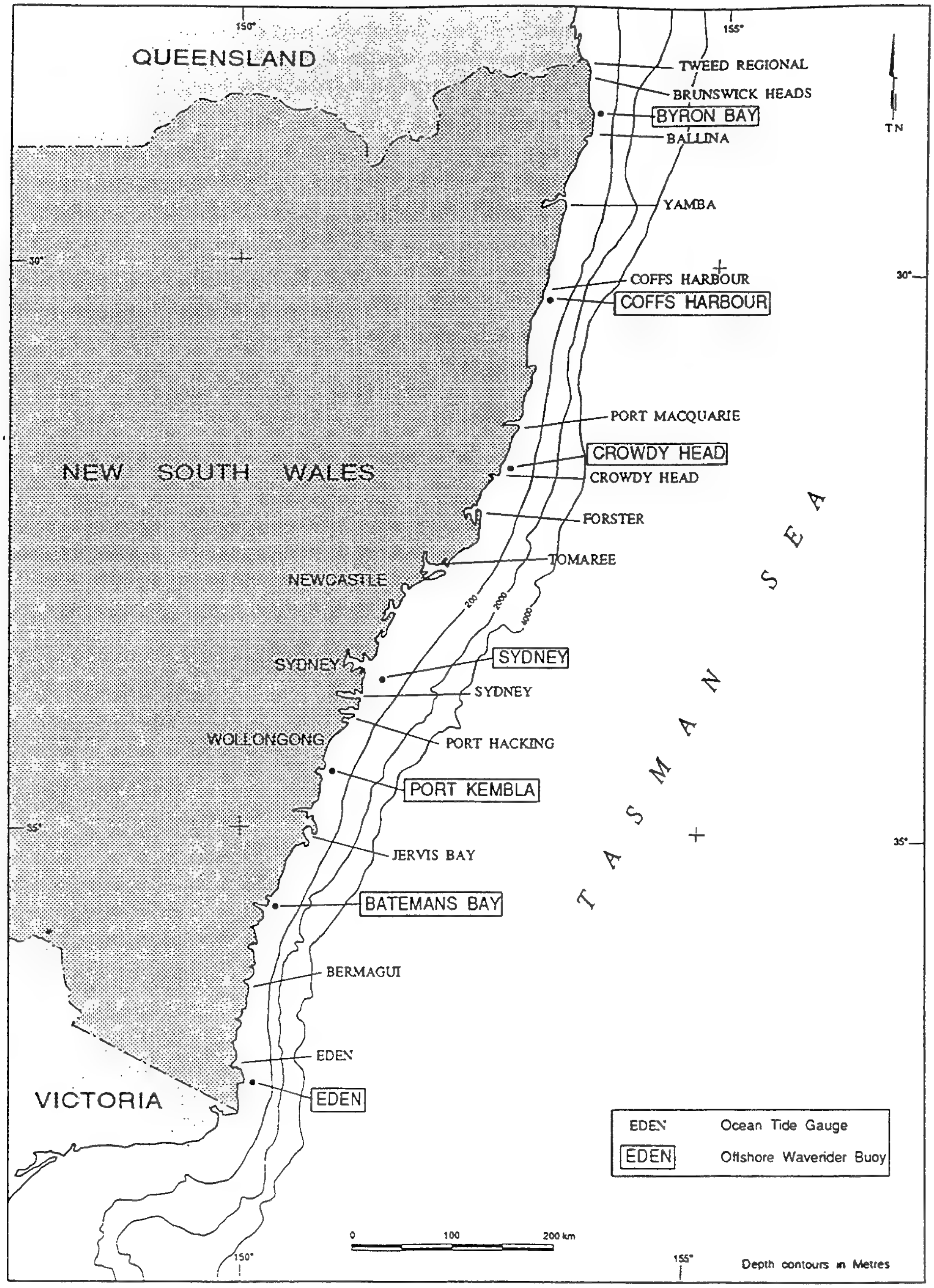


Fig. 3.2.1 New South Wales Public Works Department real-time wave-rider buoy locations 1995 (see Manly Hydraulics Laboratory report 733).

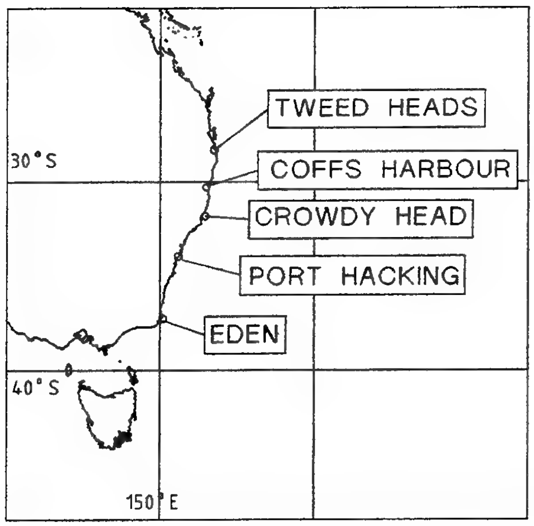


Fig. 3.2.1.1. New South Wales Public Works Department real-time Zwarts pole locations 1995 (see Manly Hydraulics Laboratory report 733).

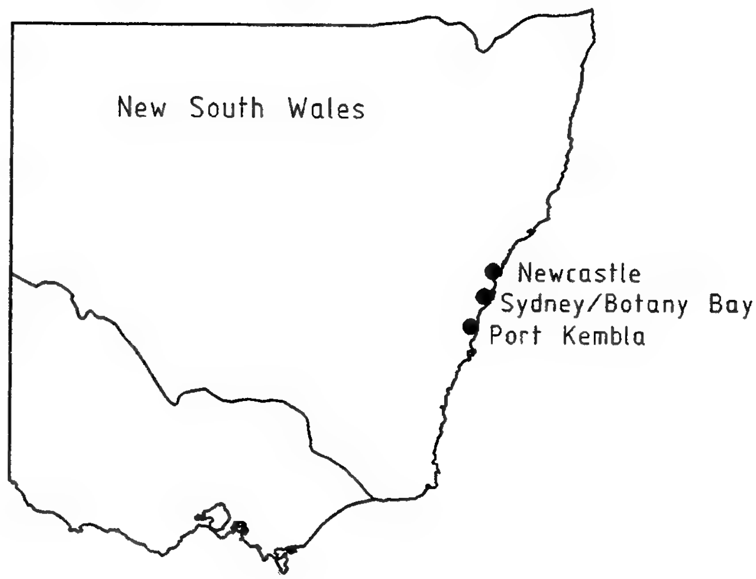


Fig. 3.2.2a. Sydney Ports Corporation real-time waverider buoy locations of the RODIS (Realtime Oceanographic Data Instrumentation Systems) network. See Willoughby et al (1995) for details.

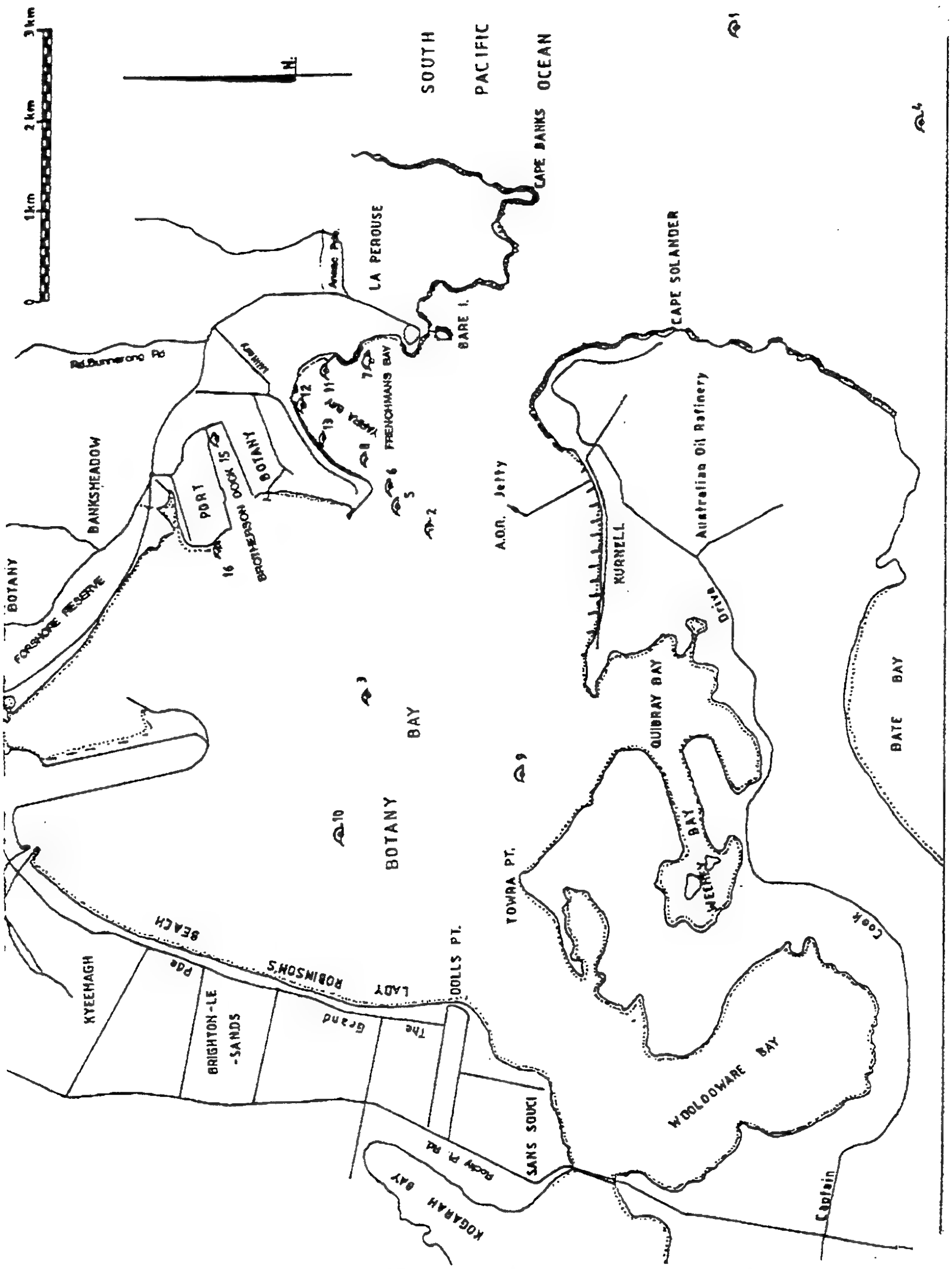


Fig. 3.2.2b. Sydney Ports Corporation waverider buoy locations in Botany Bay. Sites 2, 4, 5, 6, 10 are supplying data in real-time; other sites are historical. A directional waverider buoy is at site 10.

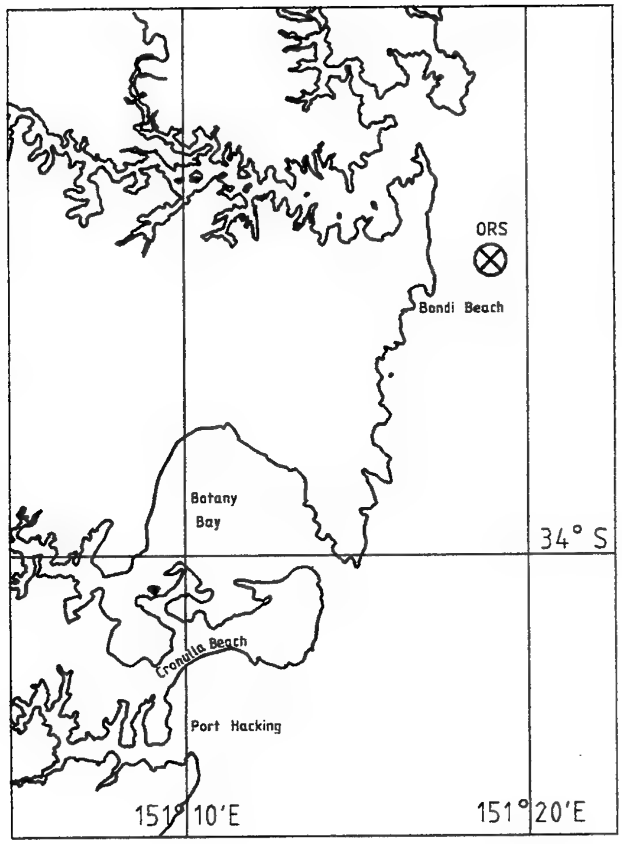


Fig. 3.2.3. Sydney Water Board real-time Ocean Reference Station (ORS) buoy location off Bondi. The buoy is fitted with a heave sensor.

3.2.3 The **Sydney Water Board** deployed a Metocean buoy at the Ocean Reference Station site in August 1990 (Fig 3.2.3), as part of their ocean outfalls commissioning and monitoring. Water depth is 65 m, and position is 33°53'S, 151°18.9'E. Users have real-time access via modem, with information updated every 30 seconds. The buoy has one heave sensor. See Rice, Trenaman and Lawson (1992) for further details. For periods longer than 6-7 seconds, data compares well with waverider data (Peter Tate AWACS). The system was installed by the Water Board, Lawson and Treloar, and AWACS.

3.2.4 The following documentation on the PWD system was provided in November 1995 by Mark Kulmar of Manly Hydraulics Laboratory:

mhl
Department of Public Works and Services

MANLY HYDRAULICS LABORATORY
110B King Street
Manly Vale NSW 2093
AUSTRALIA

Phone: (02) 9949 0200
Fax: (02) 9948 6185

WAVE DATA STATIONS

Wave data is collected by Manly Hydraulics Laboratory for the Department of Land and Water Conservation to provide essential input to design, construction and performance monitoring of coastal projects undertaken by the NSW Government. Prior to April 1995 NSW Public Works was the authority responsible to collect wave data in NSW. In April 1995, this service was transferred to the Department of Land and Water Conservation's Coastal Management Program.

Since the establishment of the then NSW Public Works' first Waverider buoy station off Port Kembla in 1974, wave data have been collected at over 30 locations along the NSW coast using a variety of wave motion sensors. In 1986 wave data collection by the Public Works was rationalised with the development of a formal deepwater wave data collection program for the NSW coast. The NSW Wave Climate Program now utilises a network of seven Waverider buoys along the NSW coast. To provide deepwater wave data, the buoys are typically moored in a water depth of 80 metres, between 5 and 12 kilometres from the shoreline. Location information and data availability for the deepwater stations is detailed in Table MHL1.

Table MHL1 NSW Wave Data - Offshore Stations: June 1995

Wave Data Site	Instrument	AMG Location*		Water Depth	Data Available		Record Length	Data Capture
		Easting	Northing	(m)	1st Date	Last Date	(years)	(%)
Byron Bay	Waverider buoy	571560	6827760	72	14-Oct-76	Present	18.71	69.9
Coffs Harbour	Waverider buoy	525600	6642550	73	26-May-76	Present	19.09	82.7
Crowdy Head	Waverider buoy	487050	6478900	79	10-Oct-85	Present	9.72	87.0
Sydney	Waverider buoy	353280	6262140	85	17-Jul-87	Present	7.95	95.2
Sydney Directional	Directional Waverider	353840	6262230	87	03-Mar-92	Present	3.32	74.8
Port Kembla	Waverider buoy	318650	6183150	78	07-Feb-74	Present	21.39	81.4
Batemans Bay	Waverider buoy	259750	6044450	73	27-May-86	Present	9.09	92.6
Eden	Waverider buoy	250000	5869580	110	08-Feb-78	Present	17.39	76.3

* Australian Map Grid coordinates relative to false origin of Zone 56.

All deepwater stations are based on the Waverider system developed by the Dutch company, Datawell. The Waverider system uses an accelerometer mounted in a loose tethered buoy (0.7 or 0.9 m in diameter) to measure the vertical accelerations of the buoy as it moves with the water surface. The accelerations are integrated twice within the buoy and the displacement signal so obtained is then transmitted to a shore station where it is processed to provide wave data statistics. Wave data is then stored in the memory of a data logger at the receiving station before being downloaded to Manly Hydraulics Laboratory's mini computer by telephone link.

A recent addition to the Waverider network is a buoy which measures the directional spectrum. A Directional Waverider buoy was deployed off Sydney in March 1992 and wave direction information is now incorporated in the wave database resident at Manly Hydraulics Laboratory. Directional information is inferred for deep water swell by visual observation and hindcasting.

In addition to the deepwater network Manly Hydraulics Laboratory undertakes site specific wave data capture programs associated with particular projects, such as breakwater design/construction, harbour design/construction, beach erosion studies, etc. A range of instruments can be used to obtain wave information. In general, the following instruments/applications are employed:

- Waverider buoys in intermediate depth water to provide wave height, period and spectral information;
- Zwarts wave poles in shallow water to provide wave height, period, spectral and tidal information;
- Marsh McBirney and InterOcean S4 electromagnetic adaptive current meters to provide XY current information over the whole spectrum. The wave components are analysed and stored in a similar fashion to the Waverider and Zwarts data. Additionally the current meters can provide wave direction information.

The location of all site specific wave data stations, including details of data availability, is presented in Table MHL2.

Table MHL2 NSW Wave Data - Site Specific Stations : June 1995

Wave Data Site	Instrument	AMG Location* Easting	AMG Location* Northing	Water Depth (m)	Data Available 1st Date	Data Available Last Date	Record Length (years)	Data Capture (%)
Tweed River	Zwarts Pole	553860	6883725	4	20-Jan-95	Present	0.44	98.0
Tweed Heads Inshore	Waverider buoy	555294	6883017	13	21-Apr-89	08-Nov-89	0.55	98.1
Tweed Heads	Marsh McBirney	555294	6883017	13	09-Jun-88	10-Oct-89	1.34	58.1
Cook Island	Marsh McBirney / S4	556003	6881182	12	09-Jun-88	25-Oct-89	1.38	39.6
Fingal Head	Marsh McBirney / S4	556079	6879564	12	09-Jun-88	25-Oct-89	1.38	28.8
Coffs Harbour Entrance	Marsh McBirney	514665	6646863	9	04-Dec-86	31-Oct-87	0.91	53.2
Coffs Harbour Roving	Marsh McBirney	Various	Locations	-	04-Dec-86	25-Nov-87	0.98	80.4
Coffs Harbour Jetty	Zwarts pole	513840	6647148	7	05-Nov-86	Present	8.65	83.1
Crowdy Head Harbour	Zwarts pole	476318	6477138	2	07-Nov-86	Present	8.64	90.9
Jimmys Beach	Zwarts pole	421665	6383610	3	16-Dec-83	08-Oct-85	1.81	85.6
Nelson Bay	Zwarts pole	419470	6379465	6	20-Jan-81	20-Apr-88	7.25	45.5
Swansea	Zwarts pole	375079	6338043	2	17-Dec-87	12-Apr-91	3.32	98.6
Broken Bay	Waverider buoy	346190	6285235	24	30-Jan-81	02-Jun-83	2.34	51.7
Palm Beach	Marsh McBirney	345650	6281755	24	19-Jun-81	14-Sep-82	1.24	41.1
Broken Bay Current	Marsh McBirney	346190	6284795	24	23-Nov-79	15-Feb-83	3.23	71.7
Mackerel Beach	Zwarts pole	342270	6281775	2	17-Aug-88	15-Oct-89	1.16	97.0
Melrose Park (Parramatta R)	Zwarts pole	321365	6255975	2	24-Mar-88	20-Jul-88	0.32	82.3
Chiswick (Parramatta River)	Zwarts pole	327650	6253076	2	28-Mar-88	20-Jul-88	0.31	72.9
Port Hacking Seaward	Zwarts pole	328830	6227575	3	06-Sep-83	Present	11.81	72.1
Deeban Spit	Zwarts pole	327850	6227474	2	15-Sep-83	03-Oct-86	3.05	51.6

Table MHL2 Site Specific Stations : June 1995 (Cont.)

Wave Data Site	Instrument	AMG Location* Easting	AMG Location* Northing	Water Depth (m)	Data Available 1st Date	Data Available Last Date	Record Length (years)	Data Capture (%)
Port Hacking Seaward MMcB	Marsh McBirney	328830	6227575	3	06-Sep-83	17-Nov-86	3.20	56.6
Deeban Spit MMcB	Marsh McBirney	327850	6227474	2	06-Sep-83	28-May-85	1.73	60.6
Burraneer Point MMcB	Marsh McBirney	327763	6227931	6	06-Sep-83	16-Dec-85	2.28	54.6
Port Kembla Inshore	Waverider buoy	307990	6184970	18	31-May-78	26-Jul-82	4.15	72.8
Jervis Bay North	Zwarts pole	287850	6120050	6	11-Nov-81	03-Jul-89	7.64	62.5
Jervis Bay South	Zwarts pole	228500	6118800	8	01-Sep-81	18-Oct-83	2.13	34.7
Batemans Bay Inshore	Zwarts pole	247792	6043097	7	26-Feb-87	08-Dec-90	3.78	94.1
Eden Inshore	Waverider buoy	758230	5892820	9	24-Nov-84	11-May-87	2.46	75.2
Eden Harbour	Zwarts pole	758324	5892999	4	24-Nov-84	Present	10.60	77.1

* Australian Map Grid coordinates relative to false origin of Zone 56.

3.3 Victoria (including Bass Strait)

3.3.1 Port Phillip Bay

The **Port Of Melbourne Authority** run a real-time system consisting of three waveriders. One buoy is in The Rip, one directional buoy is outside the entrance, and another buoy is inside the entrance. General waverider locations are shown in Fig 3.3.1. Information is displayed in real-time. Technical reports for internal use were prepared by the consultants who developed the system, but no other information is available. Hindcast data were also prepared for specific sites based on the wind field. This information was supplied by Ray Tyfhing of the Port Of Melbourne Authority on 16th October 1995.

3.3.2 Bass Strait

Real-time systems are operating on the **Kingfish B oil platform** in Bass Strait (Fig 3.3.2), using data from a wave-staff and pressure recorder. Visual estimates of wave height, period, and direction are also made from this and other platforms (see section 4.1.3). The Bureau of Meteorology in Melbourne has access to the Kingfish B data. "Routine measurements of waves commenced at Kingfish B and Barracouta platforms by Esso Australia Ltd in 1977. The wave measurements from Kingfish B are continuing, while those from Barracouta ceased in the middle of 1987. These measurements, combined with the study of Esso Australia Ltd (1990), adequately describe the offshore wave climate in eastern Bass Strait" (Black et al 1994).

3.3.3 Port Of Portland

Robin Hill of the Port Of Portland Authority advises that a wave measuring system is planned to be installed as part of an under keel clearance and long period wave monitoring programme. No wave measuring system presently exists. A precision tide gauge telemeters data at one minute intervals.

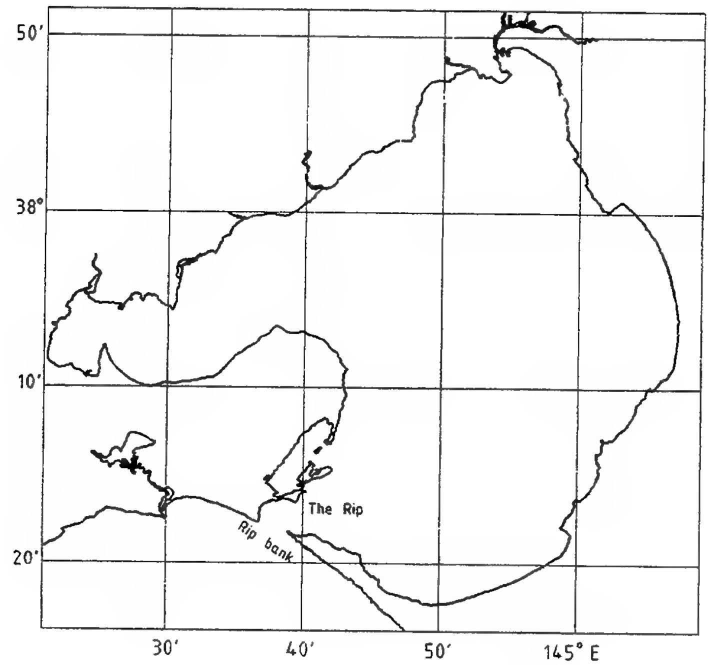


Fig. 3.3.1. Port Of Melbourne Authority real-time waverider buoy locations. Three waveriders are located near the entrance, one outside and two inside (near The Rip).

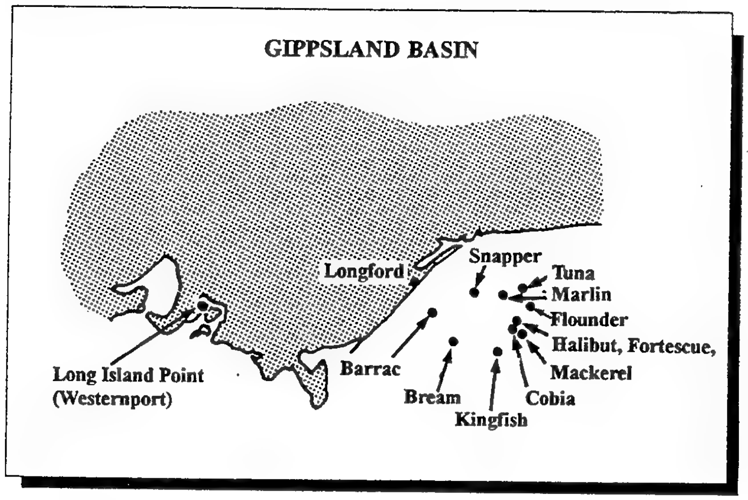


Fig. 3.3.2. Bass Strait real-time wavestaff location - ESSO Kingfish B platform.

3.4 Tasmania (excluding Bass Strait)

No information was found on operational real-time systems. A system run by CSIRO on the east coast ceased operation in 1992.

3.5 South Australia

There are apparently no operational real-time waverider systems. An earlier system was run by the Department of Civil Engineering of the University of Adelaide (Culver and Walker 1983). See section 4.6 for real-time coastal radar data for Gulf St. Vincent.

3.6 South West Australia

Off Fremantle a real-time wave monitoring system has been set up by Grant Ryan of the **Department Of Transport**. Two wave-rider buoys are operating, one offshore near Rottnest Island, and one inshore near the shipping channel (Fig 3.6). The system has been operating since February 1994. Steve Wyllie of AWACS advises that a real-time system (Zwarts electro-magnetic wave-pole) is to be installed off a dolphin near the entrance channel between Wattleup and Kwinana in Cockburn Sound for the **Fremantle Port Authority** in February 1995. Mark Kulmar of MHL advises that three more were installed in October 1996, with another at **Bunbury** in September 1996 for the Bunbury Port Authority. Harbourmaster Captain Bill Gault of Geraldton Port Authority advises that a real-time waverider data acquisition system was installed for the **Geraldton Port Authority** by WeatherNews Pty Ltd as part of a keel clearance programme. Information is displayed and updated every 10 minutes, and the data are routinely stored.

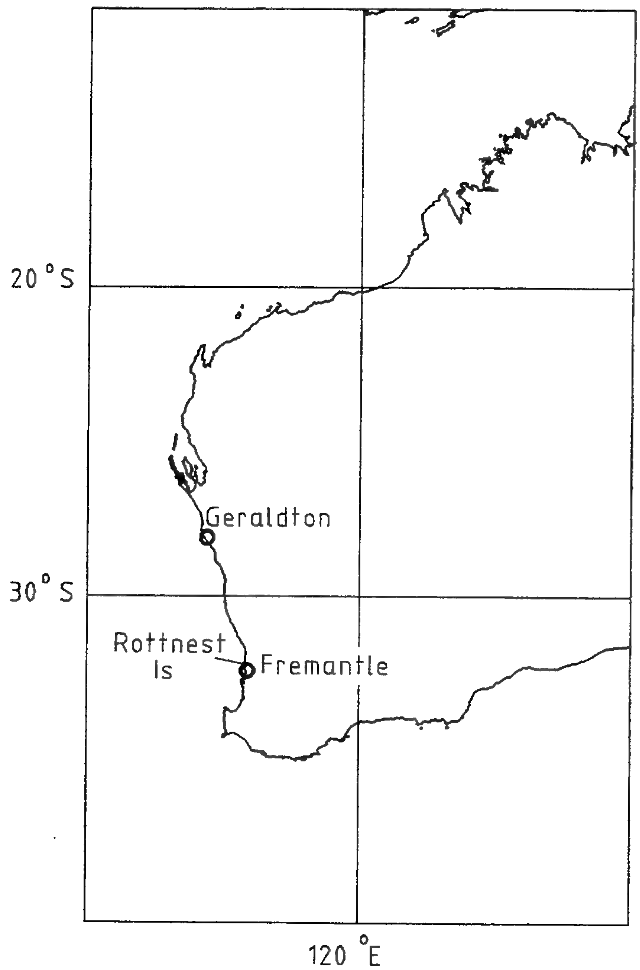


Fig. 3.6a. South-western Australia real-time waverider buoy locations - Department Of Transport, Fremantle Port Authority, and Geraldton Port Authority.

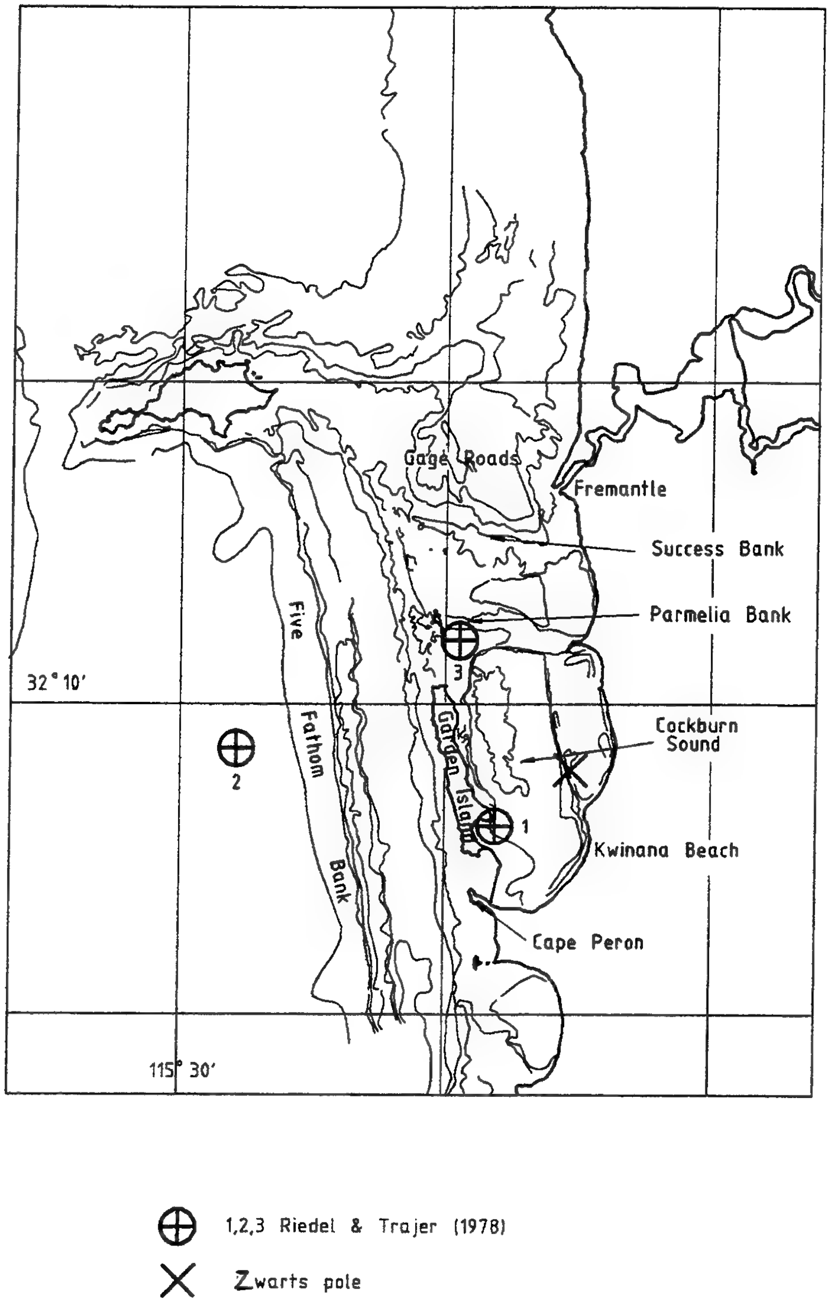


Fig. 3.6b. South-western Australia real-time wave measuring location - Zwarts pole in Cockburn Sound. Installed for Coastal Information and Engineering Services.

3.7 North West Australia

WNI (previously Steedman) Science and Engineering (a division of WeatherNews Pty Ltd) run a real-time **Remote Offshore Warning System (ROWS)**, during the cyclone season, receiving data from 6 waveriders on the North West Shelf in their Perth office via the Inmar Sat C system. The waveriders are up to 230 km from shore. The shore based computer system estimates how much deepwater energy will penetrate Mermaid Sound in 4 hours time for a keel clearance programme. Processed data are sent to a network of PCs throughout Western Australia. During the cyclone season (November to April) five directional waverider buoys are sited in an arc from **North Rankin to Mermaid Sound**, Dampier (Fig 3.7). Three Seatex waverider buoys are sited in depths of 835, 350, and 80 m, with a directional waverider at North Rankin A platform. Directional waveriders at Mermaid Sound and North Rankin are permanently deployed, with the other three buoys deployed about October. (This information was provided by Martin Holbrook and Scott Noreika of WeatherNew Inc). The Bureau of Meteorology in Melbourne has access to data from North Rankin. Carlson and Stroud (1974) describe what appears to be the origins of the North Rankin system. Woodside and Hammersley Iron intend to have a co-operatively run real-time waverider system at **Dampier** in mid-December 1995. See Lovell and Harper (1989) for details of a Mermaid Sound real-time monitoring system **MEMS** using pressure meters, which apparently operates independently of ROWS. Status of this system is unknown. A real-time swell forecast system is operating at **Port Hedland** with two waverider buoys, in a keel clearance programme. A wave pole is to be installed at Port Hedland beacon no. 16 in December 1996 for the Port Hedland Port Authority (advice from Mark Kulmar of MHL). A real-time waverider system is believed to be operating at the **Griffin Venture** site. The Jabiru oil platform in the Timor Sea had a real-time system, but Buchan and Stroud (1993) indicate wave data acquisition ceased in early 1993. It is planned to revive this system in the near future using two waverider buoys. Other real-time systems may also be operating on the northwest shelf, but no details are available for this report.

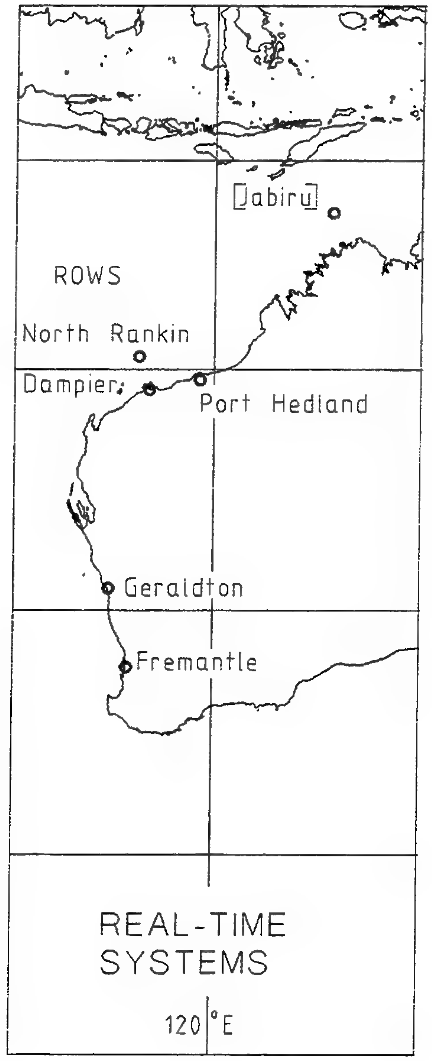


Fig. 3.7a. North West Shelf real-time waverider buoy locations - Dampier (Dampier Port Authority; Hammersley Iron/Woodside; WNI); North Rankin A (WNI); Port Hedland (Port Hedland Harbour Authority); ROWS (WNI). Systems run by other companies may also exist e.g. at Griffin Venture. A system is planned for Jabiru.

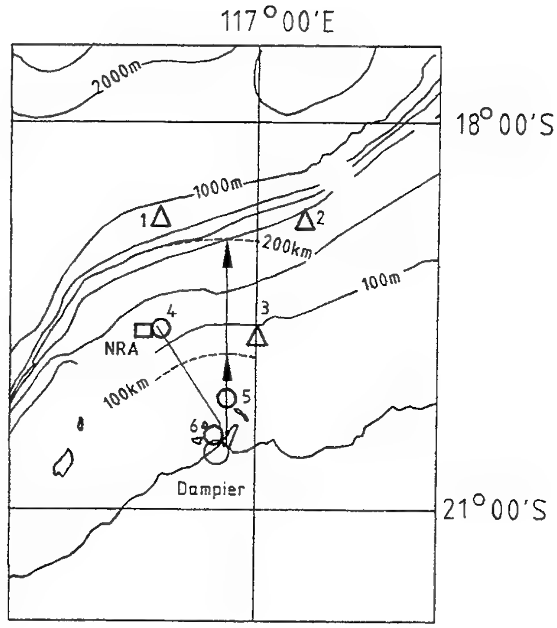
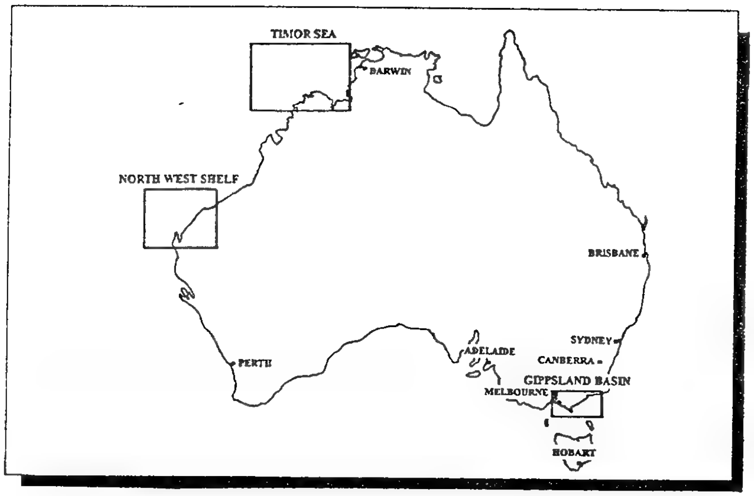
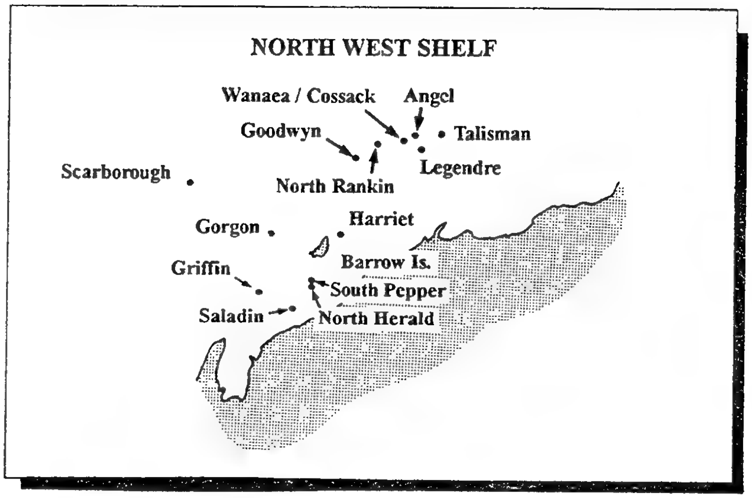


Fig. 3.7b. ROWS (Remote Offshore Warning System) of six real-time waveriders on the North West Shelf run by Weathernews Pty Ltd for Woodside Petroleum Limited during the cyclone season November to April.





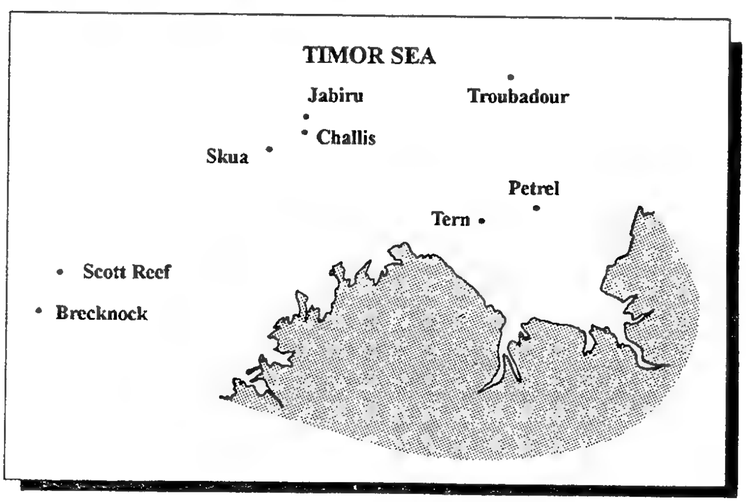


Fig 3.7c. Place names of the North West Shelf.

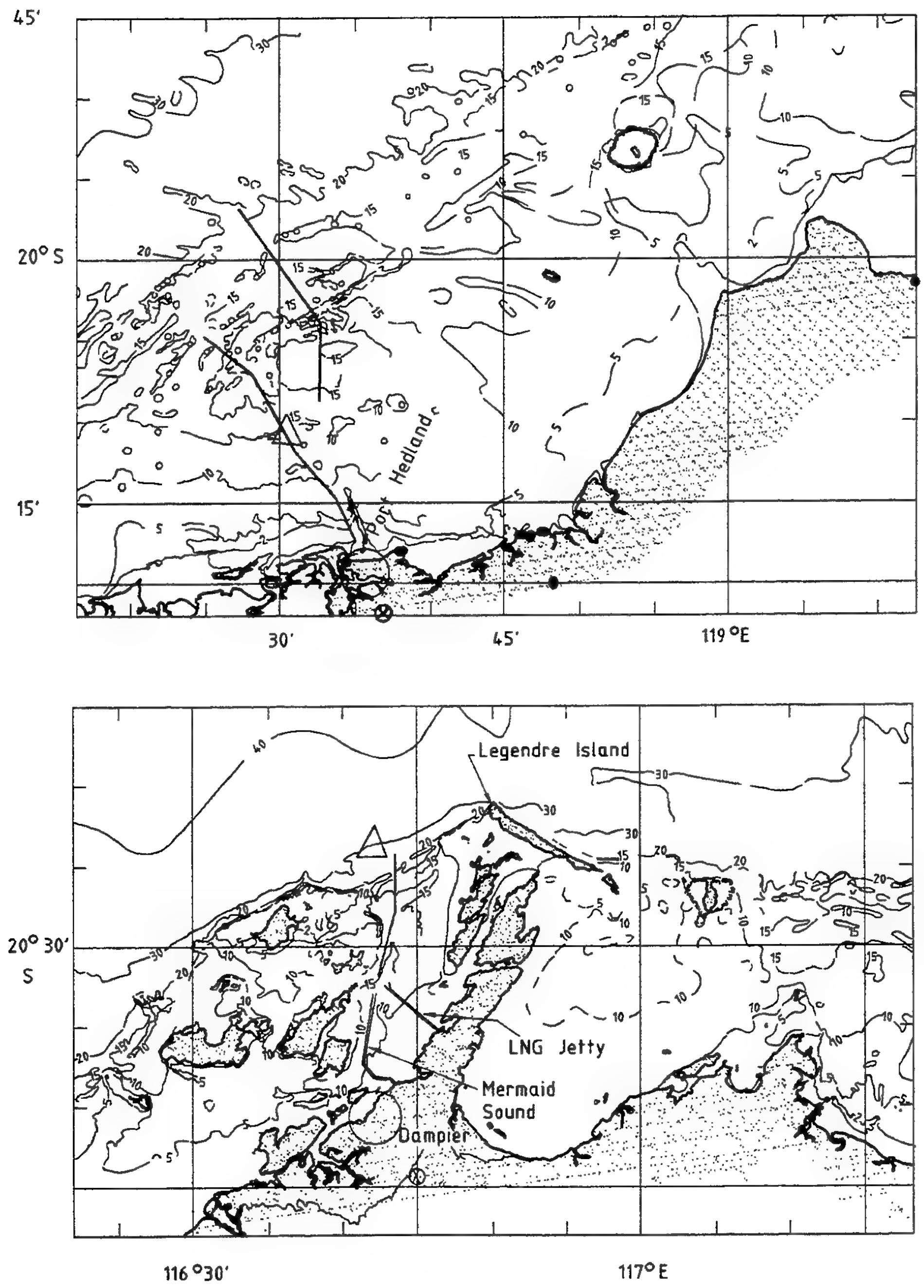


Fig 3.7d. Place names off Port Hedland and Dampier.

3.8 Northern Territory

No operational real-time systems are believed to exist. The Darwin Harbourmaster Captain Richard Wilson advises that the commercial firm AIEDA plan to install a prototype real-time "SATbuoy" off Darwin in May 1996 which will measure waves, currents, temperature, salinity, and pH. The location is approximately 12°24′ S, 130°48′ E, in a 12-15 m deep hole off East Arm (Fig 3.8). The hole is surrounded by ridges and shallow flats and may not be representative of offshore conditions.

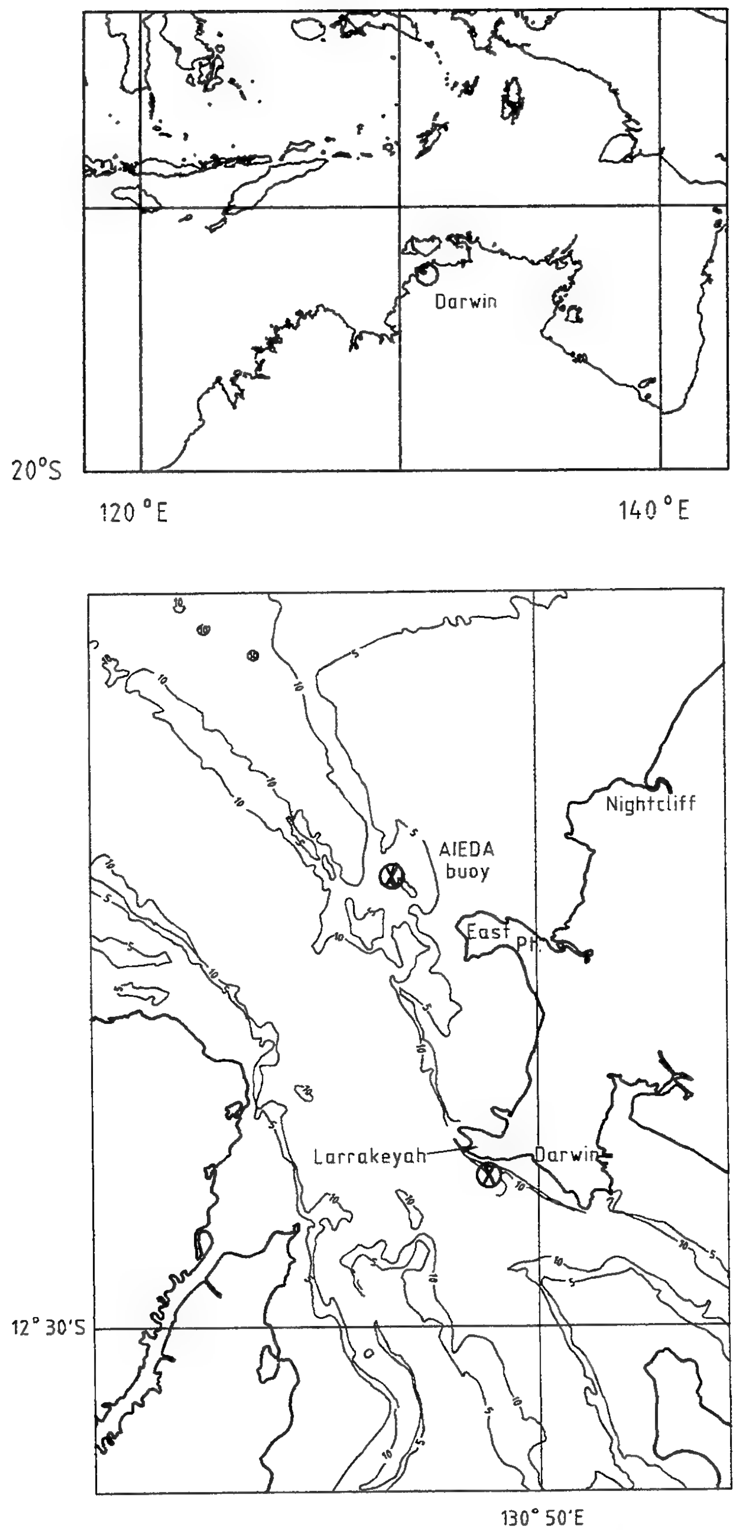


Fig 3.8. Proposed location of a prototype real-time waverider buoy system for Darwin May 1996. Information supplied by T. Cockburn (director) of AIEDA, Darwin.

4. LOWER RESOLUTION REAL-TIME WAVE DATA SOURCES

Section 3 described high resolution real-time wave data available from waverider buoys and other instrumentation. Lower resolution observations are also available from satellite, radar, and visual observations.

4.1 Australia Regional Coverage

Two types of systems providing regional coverage are briefly described: satellite and radar. Visual observations are also made from lighthouses and platforms for the Bureau Of Meteorology.

4.1.1 Satellite

Data from the **TOPEX/POSEIDON** satellite project are available over the Internet (http://podaac-www.jpl.NASA.gov/topex) as colour displays of significant wave height and as GIF files (an example is shown in Fig 4.1.1). Ten days of data are used to create the images, which are produced at about 3.33 day intervals, the period of the TOPEX/POSEIDON sub-cycle. These data are useful for broad indications of deepwater wave height. A proposed real-time system using Synthetic Aperture Radar **(SAR)** data was mentioned in section 2.2. This system is not operational. Data from the European Space Agency are available on the Internet at http://services.esrin.esa.it .

4.1.2 Skywave Radar

The **JINDALEE** over the horizon radar (OTHR) system provides large area coverage to Australia's north-west. "The experimental JINDALEE radar near Alice Springs already provides regular information about sea state and wind patterns over the area to weather forecasters, enhancing ship and aircraft safety and helping search and rescue operations" (DSTO pamphlett). By 1997 it is planned to cover the area from Geraldton to Cairns. JINDALEE propagation is essentially controlled by the ionosphere, which in turn is controlled by the sun. Accuracies are expected to be ±0.5 m or 10% for significant wave height, ±1 s for spectral peak period, and ±15° for direction. The current operational status of this system is unknown. Fig 4.1.2 shows the area presently covered, and the area planned to covered.

4.1.3 Lighthouses and Platforms

See section 5.1.3.

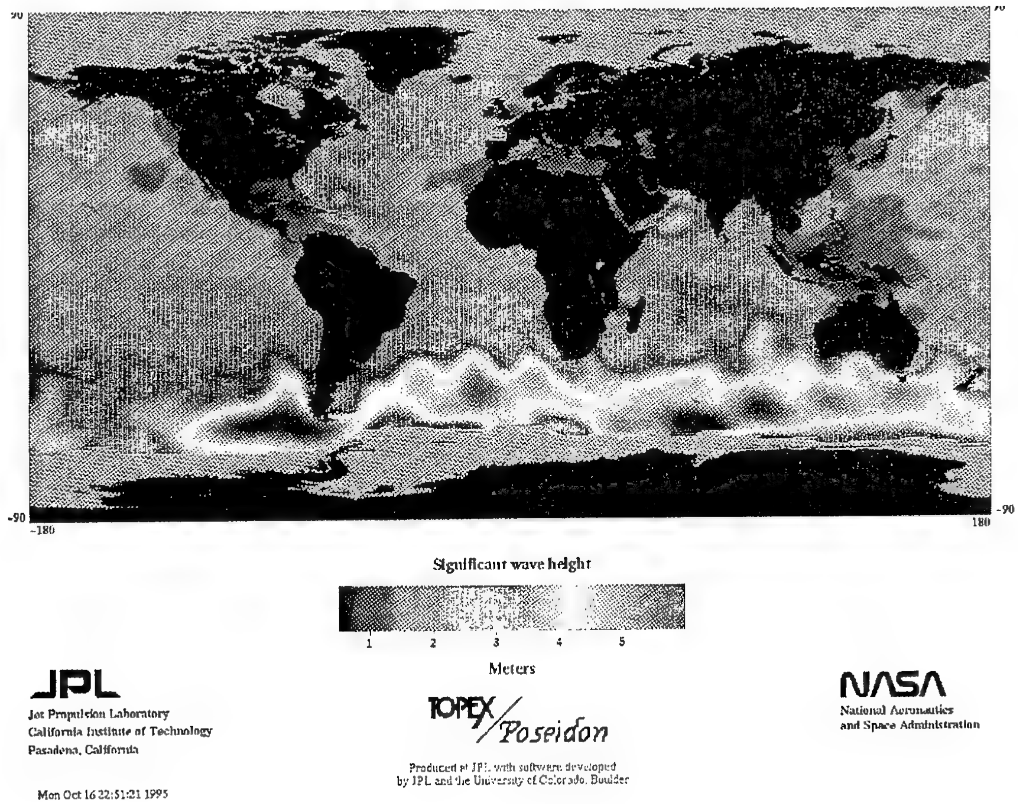


Fig. 4.1.1. Example of near real-time wave height chart for the world derived by the Jet Propulsion Laboratory and NASA using TOPEX/Poseidon altimeter data. The chart is available on the Internet [http://podaac-www.jpl.NASA.gov/topex].

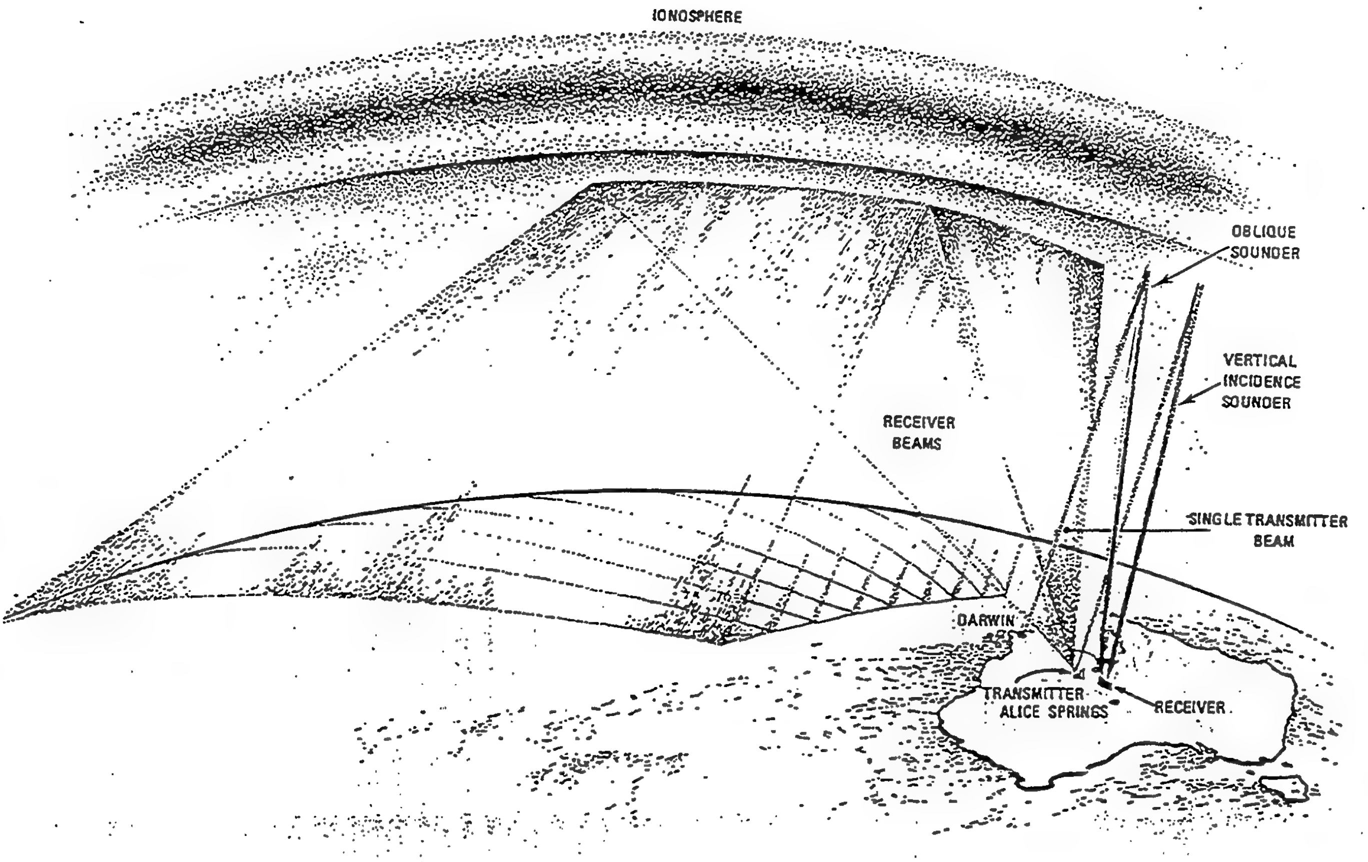


Fig. 4.1.2a. Schematic of operation of JINDALEE skywave radar used to detect oceanic wind and wave fields.

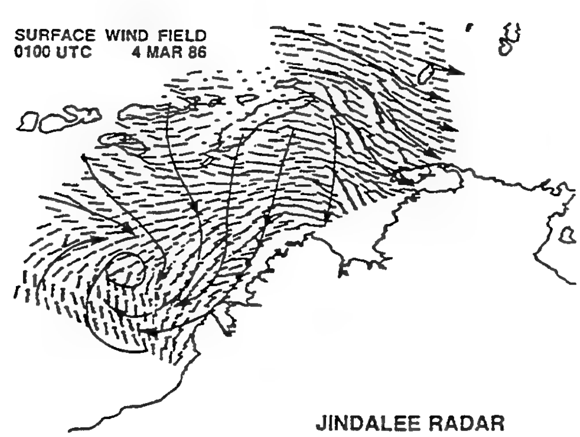


Fig. 4.1.2b. Example of near real-time wind field chart for the North West Shelf and northwest of Australia from JINDALEE radar data.

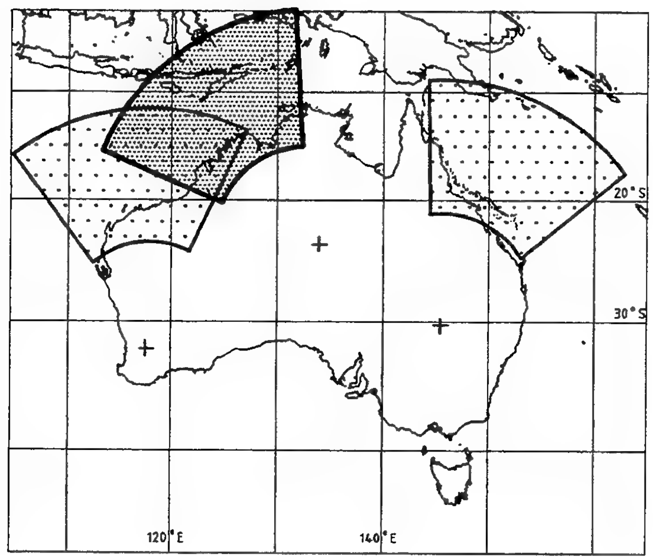


Fig. 4.1.2c. Present and planned coverage for the JINDALEE skywave radar network which is to be known as JORN (see Anderson 1977, 1986, 1990).

4.2 Queensland

"The **COPE** programme (**Coastal Observation Programme - Engineering**) has been operating for over [25] years and is continuing to supply useful data on beach, wave and wind conditions at selected sites along the Queensland coastline. Recordings are carried out daily, usually by volunteer observers complemented by Local Authority appointees, at approximately 50 stations from Port Douglas to Coolangatta with a total of approximately 1000 recordings per month." (Beach Protection Authority Queensland, 1989 Annual Report, 52pp). Fig 4.2 and Table 4.2 show details of the 1989 sites. The COPE programme is based on the Littoral Environment Observation (LEO) data collection programme of the U.S. Army Coastal Engineering Research Centre (CERC). Volunteer observers make daily observations of sea conditions, including nearshore wave heights, wave period and wave type. See section 3.1 for high resolution real-time data, and 5.1.3 for lighthouse data.

4.3 New South Wales

Regular surf reports are made by various radio stations. See section 3.2 for high resolution real-time data. It is not known whether visual observations of direction are currently made for the PWD or other organizations. See 5.1.3 for lighthouse data.

4.4 Victoria (including Bass Strait)

Visual estimates of wave height and direction are made from the oil and gas platforms and supplied to the BoM, but whether this information finds its way into real-time systems or databases is unknown. See section 3.3 for high resolution real-time data, and 5.1.3 for lighthouse data.

4.5 Tasmania

No information is available on high or lower resolution real-time systems, apart from the lighthouse information of 5.1.3.

Cope Stations Locality Map (Operating at June 30th. 1989).

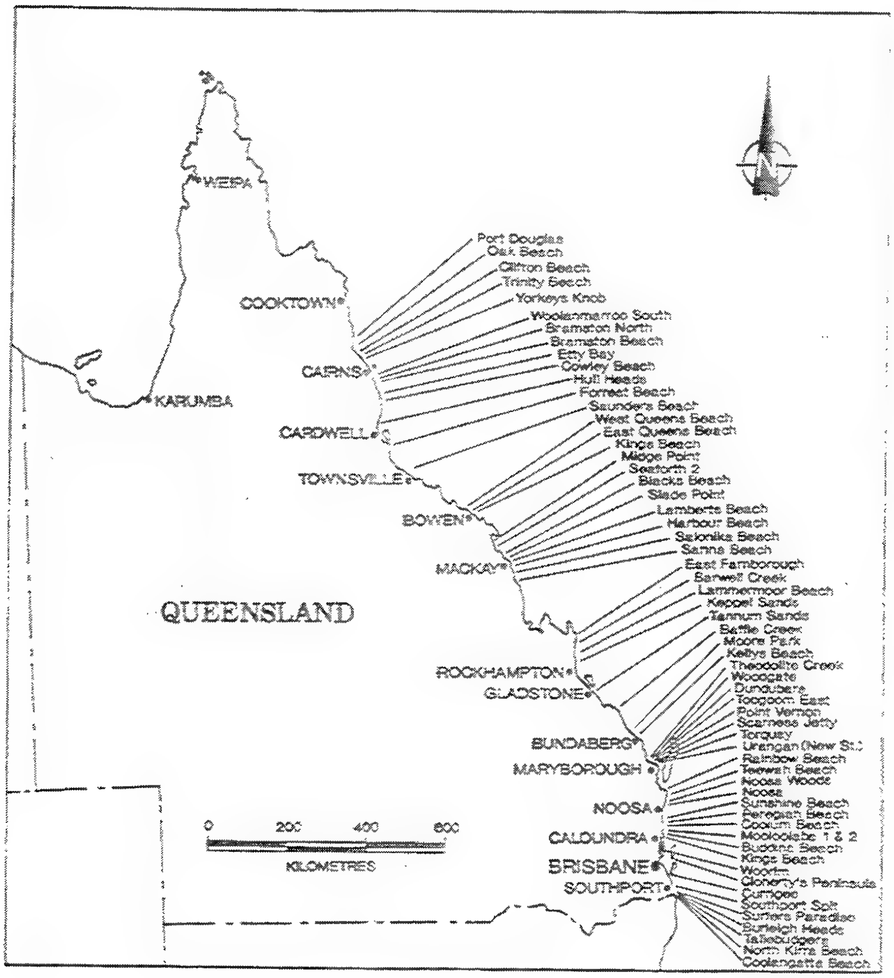


Fig. 4.2. Queensland real-time COPE stations locality map (Beach Protection Authority Annual Report 1989). Visual observations of sea and swell are made at COPE sites for the Beach Protection Authority.

Operating COPE Stations

Shire	Station Name 1.	Observer/s	Establishment Date
Bowen	East Queens Beach	Mrs S. Tremble	6-4-79
Bowen	Kings Beach	Bowen Shire Council employees	1-12-79
Bowen	West Queens Beach	Bowen Shire Council employees	2-6-81
Brisbane City	Clohertys Peninsula	Mr & Mrs R. Cameron	25-5-89
Caboolture	Woorim	Mr R. Moulang. Mr F. Bigg. Mr A. Vessey and Mrs D. Wrench	1-6-84
Calliope	Tannum Sands	Mr N. Bonell	10-10-79
Caloundra City	Buddina Beach	Mr F. Huxham. Mr S. Marriage and Mr M. Greatrex	20-12-78
Caloundra City	Kings Beach	Mrs J. McDonald and Mr H. Gough	18-9-73
Cardwell	Hull Heads	Mrs & Mrs N. O'Neill and Mr & Mrs L. Wilkie	1-12-79
Douglas	Oak Beach	None at present 2.	9-10-80
Douglas	Port Douglas	None at present 2.	7-7-81
Gold Coast City	Burleigh Heads	Mr F. Patterson	1-12-80
Gold Coast City	Coolangatta Beach	Mr P. O'Gorman	1-9-81
Gold Coast City	Currigee	Mr B. Mason	7-7-72
Gold Coast City	North Kirra Beach	Mrs M. Heriot and Mr B. Clarke	1-11-88
Gold Coast City	Southport Spit	None at present 2.	4-3-86
Gold Coast City	Tallebudgera	Tallebudgera Camp School staff	31-8-84
Gold Coast City	Surfers Paradise	None at present 2.	17-10-73
Gooburrum	Moore Park	Ms K. Favell	5-2-85
Hervey Bay City	Dundubara	Mr R. Walk. Mr D. Eckert. Mr M. Toms and Mr G. Matthews	12-9-88
Hervey Bay City	Point Vernon	Mr A. Brodie	2-3-77
Hervey Bay City	Scarness Jetty	Mr E. Nicholas	11-12-75
Hervey Bay City	Toogoom East	Mr L. Cochrane and Mr L. West	7-2-85
Hervey Bay City	Torquay	Mr G. Kruger	2-3-77
Hervey Bay City	Urangan (New St.)	None at present 2.	2-3-77
Hinchinbrook	Forrest Beach	Mrs E. Johnson	31-10-84
Isis	Woodgate	Mrs V. Fraser and Mr J. Fitzgerald	23-1-81
Isis	Theodolite Creek	None at present 2.	29-9-76
Johnstone	Cowley Beach	Mr & Mrs S. Vitali and Mr & Mrs D. Vitali	5-1-77
Johnstone	Etty Bay	Mr P. Meecham	19-2-81
Livingstone	Barwell Creek	Mr J. Fee	8-11-75
Livingstone	East Farnborough	Mr C. Hennessey	20-11-78
Livingstone	Keppel Sands	Mr D. Daniels and Mr E. Wellings	20-7-83
Livingstone	Lammermoor Beach	Mr J. Fee	7-10-75
Maroochy	Coolum Beach	Mr B. Dunne	18-11-83
Maroochy	Mooloolaba 1	Mr J. Dobell	26-7-85
Maroochy	Mooloolaba 2	Mr J. Dobell	26-7-85
Miriam Vale	Baffle Creek	None at present 2.	18-12-72
Mulgrave	Bramston Beach	Mr C. Anderson and Mr E. Accatino	19-2-81
Mulgrave	Bramston North	Mr A. Biggs and Mr B. Fegan	19-2-86
Mulgrave	Clifton Beach	Mr G. Crowley	11-9-76
Mulgrave	Trinity Beach	Mr & Mrs K. Snowdon	1-10-81
Mulgrave	Woolanmarroo South	Mr K. Fisher	8-10-80
Mulgrave	Yorkeys Knob	Mr N. Norton	19-3-73
Noosa	Noosa	Noosa Heads S.L.S.C. staff	30-5-84
Noosa	Noosa Woods	Mr W. Turner	21-8-80
Noosa	Peregian Beach	Mr R. Kenworthy and Mrs R. Barnet	5-10-88
Noosa	Sunshine Beach	Noosa Heads S.L.S.C. staff	30-5-84
Noosa	Teewah Beach	Mr W. Plant	22-3-88
Pioneer	Blacks Beach	None at present 2.	2-8-76
Pioneer	Harbour Beach	Mr N. Dew. Mr P. Hansen. Mr T. Norton and Mr D. Phillips	3-3-76
Pioneer	Lamberts Beach	Mr N. Dew. Mr P. Hansen. Mr T. Norton and Mr D. Phillips	9-4-78
Pioneer	Midge Point	Mrs H. Caldicott. Mrs D. Green. Mrs J. Jeffries. Mr I. Campbell and Mr N. Porter	19-1-89
Pioneer	Seaforth 2	Mr H. Tyzack	30-7-87
Pioneer	Slade Point	Mr & Mrs A. Rowe	10-11-80
Sarina	Salonika Beach	Mr & Mrs N. Coulter	8-4-79
Sarina	Sarina Beach	Mr G. Green and Mr P. Cosgrove	5-4-81
Thuringowa	Saunders Beach	None at present 2.	2-10-84
Widgee	Rainbow Beach	Mr L. Boyce. Ms M. Horley. Mr D. Stuart and Miss D. Stuart	4-1-77
Woongarra	Kellys Beach	Mr & Mrs H. Van Leeuwen	28-8-86

NOTES: 1. Total number of operating COPE stationing is 60.
2. Recordings made by COPE Field Officer only during visits.

Table 4.2. Details of operating COPE wave visual recording stations off Queensland as at June 30, 1989 (Annual Report Beach Protection Authority 1989).

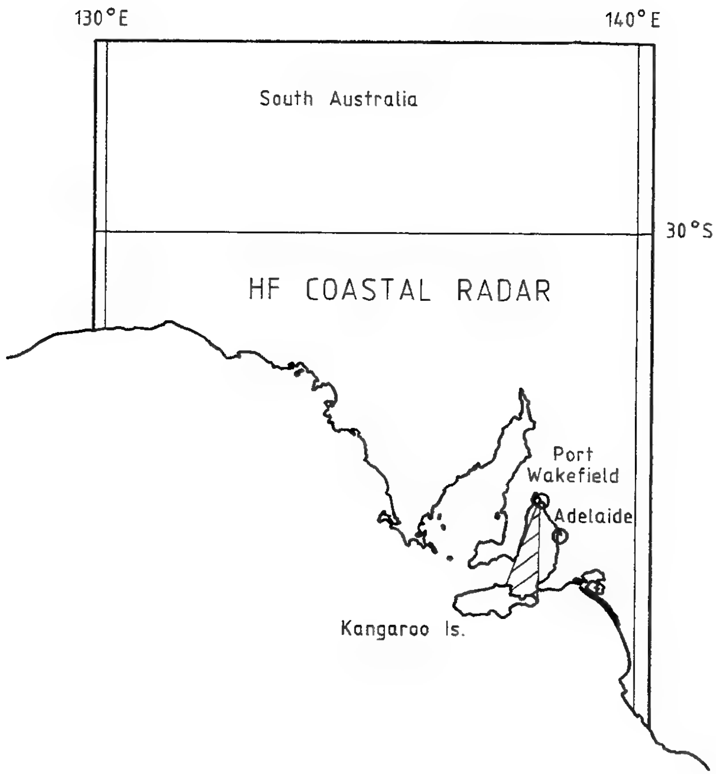


Fig. 4.6. Coverage of the DSTO High Frequency coastal radar located at Pt. Wakefield in Gulf St. Vincent. The radar supplies directional wave spectra.

4.6 South Australia

Coastal Surface Radar. The High Frequency Radar Division of DSTO Salisbury operate an experimental real-time **HF radar system** from Port Wakefield, at the northern extremity of Gulf Of St. Vincent, which sees down to Kangaroo Island (Fig 4.6). Possible range is about 300 km with spatial resolution typically 2-20 km. The radar provides directional wave spectra and surface currents, with an estimated accuracy of about 10 percent, however no validation has been made against measured data. For wind conditions above 30 knots the system loses accuracy, and theoretical investigations are underway to overcome this problem. (Information provided by Stuart Anderson of HF Radar Division DSTO in October 1995). See 5.1.3 for lighthouse data.

4.7 Western Australia

No information is available for lower resolution real-time data. Visual estimates of wave height and direction are believed to be made from the oil and gas platforms on the North West Shelf, but whether this information finds its way into real-time systems or databases is unknown. See section 3.7 for high resolution real-time data, and 5.1.3 for lighthouse data.

4.8 Northern Territory

No information is available for lower resolution real-time systems. A wave buoy is to be installed off Darwin by AIEDA in May 1996. See 5.1.3 for lighthouse data.

NOTE THAT A LISTING IN THIS DOCUMENT FOR DATA OR REPORTS DOES NOT NECESSARILY MEAN THAT THE DATA OR REPORTS ARE AVAILABLE FOR PUBLIC USE OR PERUSAL, OR THAT DATA OR REPORTS ARE FREE OF CHARGE. REQUESTS FOR DATA OR INFORMATION SHOULD NOT BE MADE TO DSTO, BUT DIRECTLY TO THE ORGANISATIONS WHICH GATHERED THE DATA.

NOTE: If you have data information or reports that could be listed in this document, please send details to the author at Aeronautical and Maritime Research Laboratory, DSTO, P.O. Box 44, Pyrmont, NSW 2009, AUSTRALIA (preferably on a DOS diskette in ASCII or WORD for Windows format; or email ASCII text to les.hamilton@dsto.defence.gov.au).

5. HISTORICAL WAVE DATA LOCATIONS BY STATE

Australia wide data are discussed first, then data for the states, starting at Queensland, and moving clockwise round Australia. Most of the organisations obtaining real-time data maintain computerised data bases or listings, and information provided by some of them is listed here in the form of charts and tables. The MIAS catalogue (1982) provided much of the information prior to 1982. The MIAS (1982) sites are shown in Fig 5a, and listed in Table 5A, with examples of MIAS details for two sites shown in Table 5B. Positions of instrumented wave measurement sites including MIAS sites are shown in Fig 5b. This is not claimed to be a complete catalogue. Information collected for organisations such as harbour authorities, and oil and gas exploration companies, are often regarded as proprietary or commercial in confidence, and are not made available for general use. Many of the publications listed in the bibliography of section 7 refer to data, but data details and status are unknown.

Listings of sites provided by WNI Science & Engineering (a division of Weathernews Pty Ltd), and Lawson and Treloar Pty Ltd are provided in Section 6, as well as being incorporated in the listings by state.

5.1 Australia

5.1.1 Satellite Data

5.1.1.1 **SEASAT** measured wave data for about three months in 1978. The US Navy oceanographic satellite **GEOSAT** operated from March 1985 to early 1990. This mission was followed in July 1991 by a European Space Agency satellite, **ERS-1**, and **TOPEX/POSEIDON** (a US/French altimeter satellite) was launched in August 1992. The latter two systems are still operational. See sections 2.3 and 4.1.1 for more details. A Canadian satellite has also recently been launched.

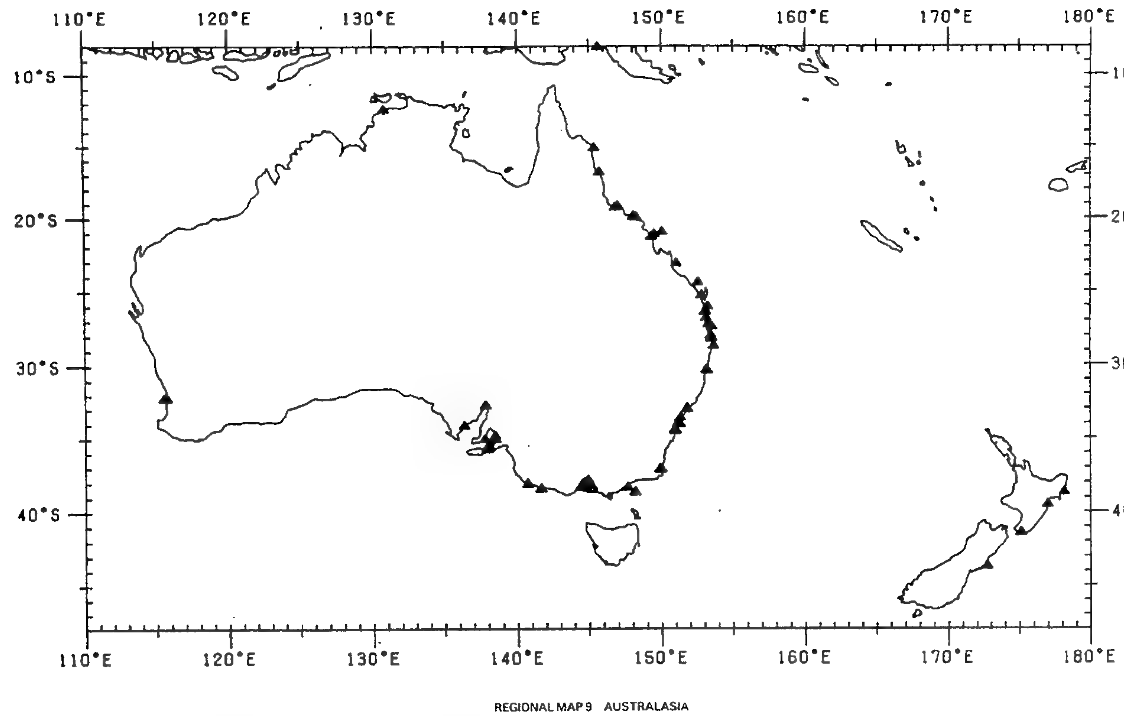


Fig. 5a. Historical Australian instrumented wave data sites from the MIAS catalogue (1982) of the British Oceanographic Data Centre.

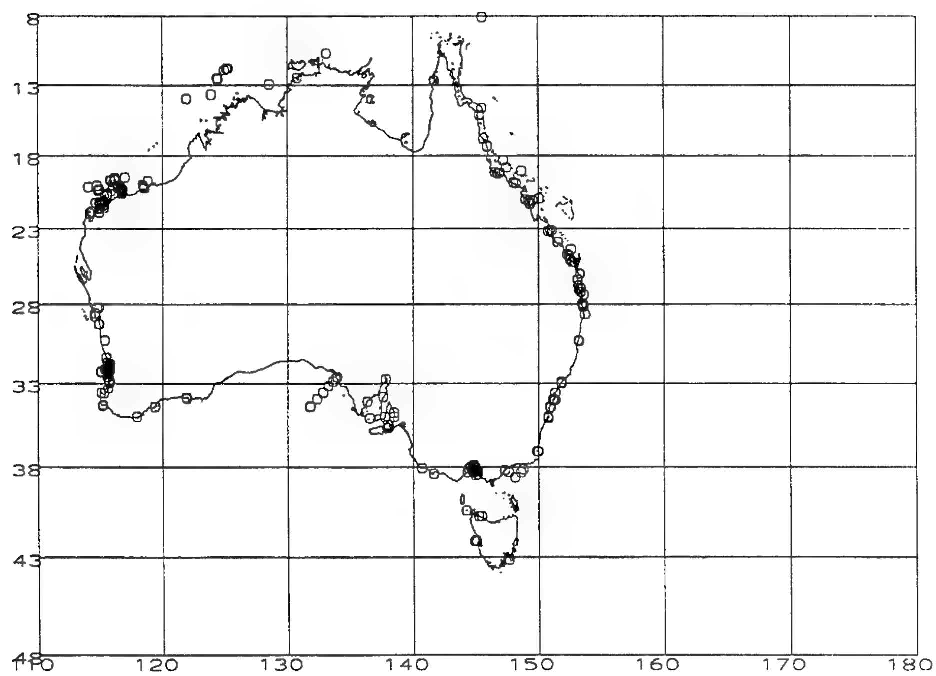


Fig. 5b. Historical Australian instrumented wave data sites listed in the present document.

Table 5A. Details of the MIAS sites shown in Fig. 5a from the MIAS catalogue (1982) of the British Oceanographic Data Centre.

AUSTRALASIA

Latitude	Longitude	Name of Location	Page
43°40' " S	172°45' " E	Lyttelton Harbour, Christchurch Bay	1
43°40' " S	172°45' " E	Lyttelton Harbour, Christchurch Bay	1
41°25'30" S	175°08'42" E	Lake Ferry, Palliser Bay, New Zealand	2
39°30' " S	177°00' " E	Napier, Hawke Bay, North Island, New Zealand	17
38°40' " S	178°10' " E	Gisborne, Poverty Bay, North Island	18
38°40' " S	178°10' " E	Gisborne, Poverty Bay, North Island	18
37°06'22" S	150°00'10" E	Eden Pilot Light, Twofold Bay	19
34°01'23" S	151°15'55" E	Botany Bay, New South Wales, Australia	19
34°00'10" S	151°10'32" E	Towra, Botany Bay, New South Wales	20
34°02'35" S	151°19'09" E	Botany Bay (site 4), New South Wales	20
34°03'22" S	151°09'31" E	Cronulla, New South Wales, Australia	21
34°27'59" S	150°56'04" E	Port Kembla, New South Wales, Australia	21
34°28'52" S	150°57'22" E	Port Kembla, New South Wales, Australia	22
34°27'32" S	150°54'30" E	Port Kembla, New South Wales, Australia	22
34°27'04" S	150°59'47" E	Port Kembla, New South Wales, Australia	23
33°59'31" S	151°12'22" E	A.O.R., Botany Bay, New South Wales	23
33°59'08" S	151°11'10" E	Runway, Botany Bay, New South Wales	24
33°58'59" S	151°10'11" E	Brighton, Botany Bay, New South Wales	24
33°59'09" S	151°12'51" E	Revetment, Botany Bay, New South Wales	25
33°58'55" S	151°13'35" E	Yarra, Botany Bay, New South Wales	25
33°59'17" S	151°12'39" E	Botany Bay (Entrance Channel)	26
33°59'11" S	151°13'38" E	Frenchman's Bay, Botany Bay	26
33°58'44" S	151°13'14" E	Revetment 115, Botany Bay, New South Wales	27
33°58'53" S	151°12'58" E	Revetment 117, Botany Bay, New South Wales	27
33°00'35" S	151°50'05" E	Nobby's Head, Newcastle, New South Wales	28
33°35'00" S	151°20'00" E	Broken Bay, New South Wales, Australia	28
33°35'00" S	151°20'00" E	Broken Bay, New South Wales, Australia	29
32°54'53" S	151°48'32" E	Nobby's Head, New South Wales, Australia	29
30°18'35" S	153°09'42" E	Coffs Harbour, New South Wales, Australia	30
30°20'38" S	153°14'07" E	Coffs Harbour, New South Wales, Australia	30
38°36' " S	148°11' " E	Kingfish B Platform, Bass Strait, Australia	31
38°18' " S	147°40' " E	Barracouta Platform, Bass Strait, Australia	31
38°01' " S	145°05' " E	Port Phillip, Victoria, Australia	32
38°08'00" S	145°05'48" E	Port Phillip, Victoria, Australia	32
38°25'48" S	145°14'54" E	Sandy Point, Westernport, Victoria	33
38°16'30" S	145°15'18" E	Yaringa, Westernport, Victoria, Australia	33
38°20'00" S	144°55'42" E	Port Phillip, Victoria, Australia	34
38°17'48" S	144°58'00" E	Port Phillip, Victoria, Australia	34
38°09'30" S	144°46'30" E	Port Phillip, Victoria, Australia	35
38°12'48" S	145°00'00" E	Port Phillip, Victoria, Australia	35
38°07'18" S	144°53'42" E	Port Phillip, Victoria, Australia	36
38°05'30" S	144°33'30" E	Wilson Point, nr. Port Phillip, Victoria	36
38°00'48" S	144°41'42" E	Werribee South, nr. Port Phillip, Victoria	37
38°18'54" S	144°24'54" E	Black Rock - Barwon Heads, Victoria	37
38°23'38" S	141°39'55" E	Danger Point, Portland Bay, Victoria	38
38°23'25" S	141°40'00" E	Danger Point, Portland Bay, Victoria	38
38°23'38" S	141°39'55" E	Danger Point, Portland Bay, Victoria	39
38°04' " S	140°43' " E	Port Macdonnell, South Australia	39
37°04'35" S	149°54'28" E	Eden breakwater, Twofold Bay	40
37°55'48" S	144°53'12" E	Port Phillip, Victoria, Australia	40
37°52' " S	144°56' " E	Port Phillip, Victoria, Australia	41
35°37' " S	138°06' " E	Cape Jervis, South Australia	41
35°02'00" S	138°30'00" E	Seacliff, Adelaide, Australia	42
35°02' " S	137°46' " E	Port Giles, South Australia	42
35°43' " S	137°57' " E	Penneshaw, Kangaroo Island, South Australia	43
35°30' " S	138°00' " E	Cape Jervis, Gulf St Vincent	43
34°47' " S	138°29' " E	Adelaide, South Australia	44
34°07' " S	136°22' " E	Port Neill, South Australia	44
32°44'00" S	137°50'00" E	Spencer Gulf, Redcliff Point	45
32°13'55" S	115°41'52" E	Cockburn Sound, Perth, W. Australia	45
32°11'38" S	115°32'22" E	Cockburn Sound, Perth, W. Australia	46
32°08'12" S	115°40'32" E	Cockburn Sound, Perth, W. Australia	46
28°06' " S	153°33' " E	Danger Point, Queensland, Australia	63
28°03' " S	153°32' " E	South Nobby, Queensland, Australia	63
28°10' " S	153°32' " E	Kirra Pt, Queensland, Australia	64
28°38'30" S	153°41'18" E	Cape Byron, New South Wales, Australia	64
27°57' " S	153°30' " E	Southport, Queensland, Australia	65
27°23' " S	153°35' " E	Brisbane (Point Lookout), Queensland	65
27°12'34" S	153°20'45" E	Brisbane, Queensland, Australia	66
26°47'30" S	153°09'30" E	Moffat Beach, Caloundra, Queensland	66
26°47'30" S	153°09'30" E	Moffat Beach, Caloundra, Queensland	67
26°01' " S	153°17' " E	Double Island Point Station, Queensland	67
26°23' " S	153°08' " E	Noosa Heads, Queensland, Australia	68
26°23' " S	153°05' " E	Noosa Beach, Queensland, Australia	68
25°15' " S	152°51' " E	Hervey Bay Station, Queensland, Australia	69
24°24' " S	152°35' " E	Burnett Heads Station, Queensland, Australia	69
23°07' " S	151°04' " E	Yeppoon Station, Queensland, Australia	70
20°57' " S	150°03' " E	Bushy Island, Great Barrier Reef, Coral Sea	70
21°16' " S	149°20' " E	Hay Point, Mackay, Central Queensland Coast	71
21°06' " S	149°32' " E	Mackay Station, Queensland, Australia	71
21°19' " S	149°23' " E	Hay Point (Highwater Islet), Queensland	72
19°52' " S	148°06' " E	Abbot Point Station, Queensland, Australia	80

19°55'	" S	148°17'	" E	Bowen, Queensland, Australia	80
19°09'	" S	147°03'	" E	Cape Cleveland, Queensland, Australia	81
19°09'	" S	147°01'	" E	Townsville, Queensland, Australia	81
19°14'	" S	146°51'	" E	Townsville Breakwater, Townsville	82
16°48'	" S	145°45'	" E	Cairns Station, Queensland, Australia	82
16°48'	" S	145°45'	" E	Cairns (inshore), Holloway Beach	83
15°07'	" S	145°24'	" E	Three Isles, Great Barrier Reef, Coral Sea	83
12°27'30"	S	130°49'12"	E	Darwin, Northern Territory, Australia	84
08°04'35"	S	145°38'40"	E	Kerema, Papua, New Guinea	88

Table 5A (cont'd). Details of the MIAS sites shown in Fig. 5a from the MIAS catalogue (1982) of the British Oceanographic Data Centre.

RNODC(Waves) MIAS Catalogue of Wave Data 1982 (lxv)

MIAS REF. 217 — SQUARE 0522 29

LOCATION	
Position:	37°08'22" S 150°00'10" E
Location:	8.7m from Eden pilot light on a bearing of 115° true, Twofold Bay, New South Wales, Australia. Sea area: Tasman Sea.
Period covered:	Start date: 08 Feb 1978 End date: Continuing *
Mean water depth:	58.5 m
Mean tidal range:	1.1 m (Spring) m (Neap)
Maximum currents:	m/sec.
Local environment:	Sandy sea bed. No effect on results due to location.
INSTRUMENT	
Instrument type:	Waverider
Type of mounting:	Mooring to anchor chain
Record duration:	10 min.
Record interval:	6 hr.
REASON FOR RECORDING	Collection of long term wave data along New South Wales coastline.
DATA	
Original data:	Chart records.
Presentations:	Tables of Date, Time, Hs, Hmax, Tz and Wave Direction. Graphs of Hs vs Time.
NOTES	* Continuing as of September 1981.
DATA CONTACT	N.S.W. Department of Public Works, King Street, Manly Vale, New South Wales, Australia.

RNODC(Waves)

MIAS REF. 401 — SQUARE 0522 58

LOCATION	
Position:	34°01'23" S 151°15'55" E
Location:	Botany Bay, New South Wales, Australia. Sea area: Tasman Sea.
Period covered:	Start date: 01 Apr 1971 End date: Continuing *
Mean water depth:	73 m
Mean tidal range:	1.32 m (Spring) 0.83 m (Neap)
Maximum currents:	m/sec.
Local environment:	Offshore site. Sandy seabed. Botany Bay unaffected by refraction or diffraction; however, some reflected waves from coastal cliffs 2 miles away
INSTRUMENT	
Instrument type:	Waverider
Type of mounting:	Elastic mooring
Sample frequency:	2 Hz.
Record duration:	20 min.
Record interval:	6 hr.
REASON FOR RECORDING	Port development.
DATA	
Success rate:	87% to 95% of possible records were taken.
Processed data:	Listings as printout or on punched paper tape; Tz, Tc, Hs, Hrms, Energy, Hmax, Epsilon, (for all recordings).
Presentations:	Spectral analysis and peak period of spectrum (selected recordings only).
REPORTS	See Appendix C.
NOTES	Hydraulic Model of Botany Bay. * Continuing as of June 1979.
DATA CONTACT	Maritime Services Board of New South Wales, New South Wales, Australia.

MIAS Catalogue of Wave Data 1982

Table 5B. Examples of MIAS meta-data for two sites from the MIAS catalogue (1982) of the British Oceanographic Data Centre.

5.1.1.2 The **Waves From Space project** used synthetic aperture radar data to prove the concept of predicting directional wave spectra around Australia in conjunction with marine winds and numerical models (Ocean Technology Group, University Of Sydney pamphlett, June 1994). The system is not presently operational. There are potential receiving stations in Alice Springs and Hobart. The possibility exists to provide wave forecasts 24 hours in advance. A data base was formed incorporating SAR and altimeter data. SAR resolutions of 25 m x 25 m are obtainable, however the information is along a swathe rather than being whole area coverage. For further details see Jones, I.S.F., A. Maheswaran, F. Ientile and L. Rufatt (1992). "An Australian Real-time Satellite Wave Spectra Delivery Scheme", Proc. 7th National Space Engineering Symposium, Canberra, p. 175. For this project, Lawson, Rice and Szylkarski (1994) describe **The World Altimeter Data Base,** a global database of wave heights derived from satellite altimetry. Each data record represents the integration of wave conditions along a 7 km satellite track. Data near shorelines may not be reliable when the satellite crosses from land to water and were removed. Wave heights less than a metre were not measured accurately, with the altimeter accuracy quoted as ±0.5 m.

5.1.1.3 GEOSAT altimeter data are now available. OCEANOR (Satellite Application Group, OCEANOR, Pir-Senteret, N-7005 Trondheim, Norway) has recently launched a PC MS-Windows© product called **World Wave Atlas** which presents calibrated, quality controlled GEOSAT altimeter data including wave statistics and extreme value analysis for any area globally. (Quote from "Wave-Climate Assessment By Satellite Remote Sensing" by Dr. Stephen F. Barstow and Dr. Harald E. Krogstad in Sea Technology, October 1995, Volume 36, No. 10, pp31-38). A demonstration version may be found on the Internet at http://www.oceanor.no/wwa/wwa. The CD-ROM **Atlas of the oceans: Wind and Wave Climate** by Young I.R. and Holland G.J. (1996) is available from Elsevier Science B.V., P.O. Box 211, 1000 AE Amsterdam, The Netherlands. Details may be found at WWW.http://www.elsevier.nl.

5.1.2 Waverider Data Obtained By Ship

HMAS Cook, the former oceanographic research vessel of the Royal Australian Navy, was used to deploy waverider buoys for short periods (hours) at various shallow and deep sea locations about Australia from 1985 to 1990. This data set is available from the **Australian Oceanographic Data Centre**. See Fig 5.1.2 for a chart of positions. Timing and location details are listed below.

```
##   AODC                              YEAR DAY START TIME(UTC)
##   FILE  START LAT  START LONG YY  DD Centisecs after midnight
 1,  2-1.2,-30.819998,153.606339,85, 58,4460516,
 2,  3-0.2,-33.96833 ,151.284271,85, 70,2565061,
 3,  3-1.2,-35.121468,150.719116,85, 70,4507371,
 4,  3-2.1,-37.220757,150.227631,85, 71, 259180,
 5,  5-2.8,-14.990566,116.980492,85, 84,7768349,
 6,  5-3.2,-15.092791,116.920815,85, 85,  31949,
 7,  6-0.1,-15.210379,116.814323,85, 85,8243627,
 8,  6-1.2,-15.204156,116.771599,85, 86,5775360,
 9,  6-2.2,-15.256834,116.71727 ,85, 87,3737546,
10,  7-0.1,-15.354188,116.666031,85, 88,1049796,
11,  7-1.1,-15.300673,116.708389,85, 88,7482966,
12,  7-2.1,-15.480102,116.598717,85, 89,4646416,
13,  8-0.2,-15.456155,116.480873,85, 90,1643916,
14,  8-1.2,-15.542092,116.347252,85, 90,7495641,
15,  8-2.2,-15.718797,116.15877 ,85, 91,5266691,
16,  9-0.2,-15.866769,116.052513,85, 92,2415518,
17,10-0.13,-12.585955,108.484795,85,101,6883990,
18, 10-1.1,-12.554455,108.383987,85,101,7032524,
19, 10-2.2,-12.032132,106.550842,85,102,1352759,
20, 10-3.2,-12.045157,106.495865,85,102,3285586,
21, 11-0.2,-12.164826,106.382034,85,103, 538945,
22, 11-1.2,-12.279218,106.389519,85,103,6244018,
23, 11-2.1,-12.314687,106.427757,85,104,2151634,
24, 11-3.2,-12.362967,106.47097 ,85,104,3856543,
25, 12-0.2,-58.643326,104.102623,85,105,3627887,
26, 12-1.1, -6.981812,104.713699,85,106,4567379,
27, 12-2.2, -5.345385,107.014885,85,107,2409069,
28, 13-0.2, -6.290038, 97.413284,85,119, 378752,
29, 13-1.2, -1.783815, 95.008072,85,120,2236487,
30, 14-0.1, -0.251763, 95.166214,85,120,5113789,
31, 14-1.2, -6.148782, 95.741859,85,121,4721080,
32, 14-2.2,-10.556853, 96.021584,85,122,2760711,
33, 14-3.2,-13.075747, 95.966927,85,122,6770347,
34, 15-0.2,-15.382919, 98.175522,85,123,8190571,
35, 15-1.2,-20.237438,103.11615 ,85,125,1438153,
36, 15-2.2,-23.937747,107.209915,85,126,1674103,
37, 16-0.2,-27.919006,111.382874,85,127,1698107,
38, 16-1.2,-31.907537,115.510406,85,129,2009767,
39, 16-2.2,-35.196739,116.261894,85,130,3416071,
40, 17-0.2,-36.014065,121.657661,85,131,3021613,
41, 17-1.2,-37.199341,129.252319,85,132,4048476,
42, 17-2.2,-38.194229,137.260376,85,133,5040752,
43, 17-3.2,-38.882462,143.808868,85,134,5180205,
44, 18-0.2,-38.372585,144.607071,85,139,2714581,
45, 18-1.2,-38.557743,149.207962,85,139,8610158,
46, 18-2.2,-37.080597,150.87059 ,85,140,4664694,
47, 18-3.1,-34.20295 ,151.404755,85,144, 240329,
48, 18-4.2,-35.102117,150.827011,85,147,4110066,
49, 19-0.2,-33.855721,151.334335,85,203,2442842,
50, 19-1.2,-34.532154,152.049393,85,203,4390369,
51, 19-2.3,-35.84148 ,153.024231,85,204,2374074,
52, 19-3.2,-35.900833,152.933334,85,205,5181517,
53, 20-0.2,-39.246468,155.968246,85,206,7315554,
54, 20-1.1,-37.5826  ,155.530685,85,207,8293936,
```

```
##   AODC                            YEAR DAY START TIME(UTC)
##   FILE  START LAT  START LONG YY  DD Centisecs after midnight
55, 20-2.2,-36.243404,153.421112,85,209, 658583,
56, 21-0.2,-36.501682,152.02713 ,85,209,44244325,
57, 21-1.1,-34.042534,151.47522 ,85,213, 376171,
58, 44-4.2,-18.144308,178.396774,86, 68,8083592,
59,49-0.15,-33.223923,156.41716 ,86,122,7763934,
60,49-1.38,-38.083035,151.73642 ,86,127, 792226,
61, 49-2.1,-38.082905,151.73645 ,86,127, 799324,
62, 59-6.2,-38.764271,168.045456,87, 48,5197316,
63,60-0.22,-40.790993,160.712189,87, 56,7617161,
64, 60-1.2,-40.133507,155.346893,87, 58,8307532,
65, 61-5.9,-39.196461,150.897491,87, 77,8400491,
66, 62-2.3,-35.038769,150.890335,87,126, 369610,
67, 62-3.6,-34.537155,151.177307,87,127,1687149,
68, 64-3.7,-32.753139,157.503067,87,148,2249226,
69, 65-3.2,-33.627907,153.814148,87,210,2761468,
70,66-7.32,-18.650902,176.813751,87,234,6980451,
71, 67-4.2,-35.853497,174.642426,87,253,7750505,
72, 68-3.2,-31.90374 ,156.16745 ,87,265,2404136,
73,69-3.15,-33.845337,154.696854,87,313,8549569,
74,69-4.22,-31.843035,155.820572,87,315,1329583,
75, 71-0.2,-34.704159,138.619431,87,340,7723929,
76, 71-1.1,-33.323273,151.940689,88, 32,1843878,
77, 71-2.2,-31.91507 ,153.26825 ,88, 32,5420567,
78, 71-3.2,-30.877054,153.55098 ,88, 32,7558817,
79,73-12.4,-20.665691,149.650375,88, 85,1995446,
80,74-1.14,-22.021172,155.078934,88, 88,8290107,
81,75-9.31,-17.403481,147.662689,88,342, 371639,
82,75-10.2,-17.198454,147.842484,88,342,3600038,
83,75-11.2,-17.336298,147.837112,88,343,48270550,
84, 76-4.3,-17.557398,152.502808,88,348,1342955,
85,76-5.13,-32.920277,152.564392,88,350,8018220,
86, 80-0.5,-33.862118,151.222733,89,110,2686246,
87, 80-2.6,-33.753864,152.348419,89,110,2686246,
88, 81-0.2,-33.924088,151.201065,89,110,1994714,
89,80-16.2,-33.948891,152.398376,89,118,1805532,
90,80-22.5,-34.022083,151.897113,89,122,3734458,
91,82-4.35,-14.783478,152.784485,89,147,7562275,
92, 83-1.8,-14.783478,152.784485,89,147,7562275,
93, 83-0.2,-14.845834,153.069977,89,147,8032744,
94, 83-2.2,-15.057235,154.014313,89,148, 939255,
95, 85-0.1,-34.704159,138.619431,89,201,8233835,
96, 85-5.1,-34.704159,138.619431,89,201,8233835,
97, 93-0.2, -5.092099,106.67495 ,90, 71,1901514,
98, 93-3.2,-34.704159,138.619431,90,201,8233835,
```

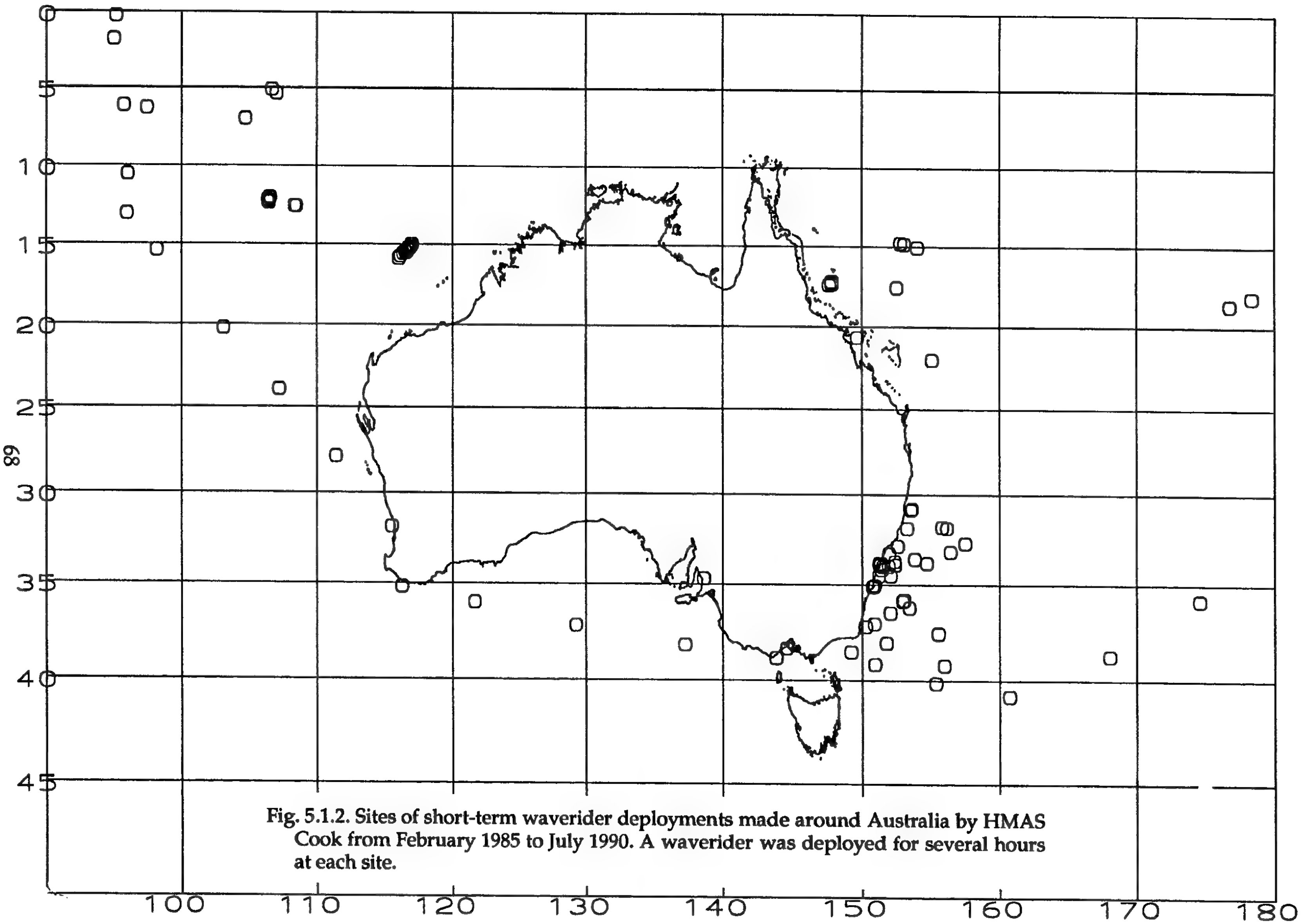


Fig. 5.1.2. Sites of short-term waverider deployments made around Australia by HMAS Cook from February 1985 to July 1990. A waverider was deployed for several hours at each site.

5.1.3 Lighthouses and Platforms

Visual observations made from lighthouses, platforms, and shipping are available from the **Bureau Of Meteorology** (BOM). Note that several of the references deal with lighthouse data e.g. Underwood (1987) for Tasmania. The list of sites and details was supplied by Helmet Abt of the BOM. Several of the locations are shown in Fig 5.1.3.

```
Following are lists of sites that were/are reporting sea and
swell. Parameter details are shown below.

 SITENO     =  Bureau indentification number - quote when enquiring.
 WMONO      =  World Meteorological Organisation Index Number
 PRIM       =  The Primary name of the station.
 SEA        =  Consists of the following strings of information:
               CHR  1-2  -  is a code of type of sea observation:
               .     00  -  No sea state observations
               .     01  -  Sea/swell by estimation
               .     02  -  Sea/swell by measurement
               .     03  -  sea temperature measurement
               .     10  -  00 & 03
               .     11  -  01 & 03
               .     12  -  02 & 03
               CHR    3  -  BOM use
               CHR14-13  -  Commencement date of observations (Many will not have
  an entry
               CHR14-23  -  Cessation date of observations    (Many will not have
an entry)
               CHR24-25  -  BOM use
OPENDATE    =  When station opened.
CLOSEDATE   =  When station closed.
PURPR       =  Present routine purpose of station.
            =  If this is not Synoptic then it has been at some point in time or
               the sea and swell observations are performed only during "Cyclone
  Season" during an Alert Period. If blank the station has closed.

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```

SITENO	WMONO	PRIM	SEA	OPENDATE
003004		BROOME	01604/05/1939 / / NN	//1917
004090		KARRATHA	016 /03/1984 / / NN	
008282		ABROLHOS ISLANDS	01218/03/198622/05/1987 Y	18/03/1986
009038	94603	ROTTNEST	012 / / / / NN	/ /1880
009518	94601	AUGUSTA	012 / / 03/02/1993NN	/ /1897
009519	94600	BUSSELTON	016 / /1904 / / NN	/ /1903
009875		MOUNT BARKER	11610/04/198524/01/1986NY	10/04/1985
014008		CAPE DON LIGHTSTATION	016 / / /10/1990NN	/ /1917
014011		MINJILANG	016 / / 06/10/1988NN	/ /1947
014153	94134	BLACK POINT	01212/09/1990 / / NN	/ /1965
014504	94146	ELCHO ISLAND	012 / / / / NN	/ /1937
018070	94660	PORT LINCOLN	016 / / / / NN	/ /1866
018115	94804	NEPTUNE ISLAND	012 / / / / NN	/ /1957
022029		ALTHORPE ISLAND	01 /05/1968 /11/1981NN	/ /1968
022801	94805	CAPE BORDA	012 / / / / NN	/ /1865
022803	94822	CAPE WILLOUGHBY	012 / / / / NN	/ /1881
022833		CAPE DE COUEDIC/SEATEMP	032 / /1976 / / NN	/ /1976
026005	94818	CAPE NORTHUMBERLAND	012 / /1938 / / NN	/ /1864
026026	94812	ROBE	016 / / / / NN	/ /1860
027022		THURSDAY ISLAND MO	012 / / 28/02/1993NN	/ /1950
031037	94285	LOW ISLES	012 / / / / NN	/ /1887
031084		FITZROY ISLAND	016 / / 12/03/1991NN	/ /1962
032004	94292	CARDWELL	012 / / / / NN	/ /1871
033119	94367	MACKAY	012 / / / / NN	/ /1959
033138		MACKAY	016 / / / / NN	/ /1969
039059	94388	LADY ELLIOTT ISLAND LIGHTHOUSE	012 / / / / NN	/ /1939
039085	94390	SANDY CAPE LIGHTHOUSE	012 / / / / NN	/ /1871
040043	94594	CAPE MORETON LIGHTHOUSE	016 / / / / NN	/ /1869
040660		MIAMI	012 / / / /1978NN	/ /1976
040856	94564	RAINBOW BEACH	01210/06/1992 / / NN	10/06/1992
058009	94595	CAPE BYRON LIGHTHOUSE	012 / /1948 / / NN	/ /1948
058012	94589	YAMBA	012 / /1877 / / NN	/ /1877
059030	94790	SMOKY CAPE LIGHTHOUSE	012 / /1939 / / NN	/ /1939
061055	94774	NEWCASTLE	012 / /1920 / / NN	/ /1862
061273	94770	NORAH HEAD	01211/07/1969 / / NN	/ /1969
068034	94940	JERVIS BAY	012 / /1907 / / NN	/ /1899
069017	94939	MONTAGUE ISLAND LIGHTHOUSE	01230/11/1968 / / NN	/ /1949
069018	94937	MORUYA HEADS	012 / / / / NN	/ /1875
069055		GREEN CAPE	012 / / / / NN	/ /1904
075028		GRIFFITH CSIRO	012 / / 30/06/1989	/ /1914
084016	94933	GABO ISLAND	012 / / / / NN	10/06/1859
084070	94932	POINT HICKS LIGHTHOUSE	012 / / / / NN	01/05/1962
084083	95904	LAKES ENTRANCE	012 / / / / NN	01/09/1965
085096	94893	WILSONS PROMONTORY LIGHTHOUSE	012 / / / / NN	/ /1872
085258		BARRACOUTA	012 / / / / NN	/ /1972
085259		HALIBUT	012 / / / / NN	/ /1972
085260		MARLIN	012 / / / / NN	/ /1972
085261		KINGFISH A	012 / / / / NN	/ /1972
085262		KINGFISH B	012 / / / / NN	/ /1972
086017		CAPE SCHANCK	012 / / / / NN	01/11/1879
090014	94826	CAPE NELSON	016 / / / / NN	01/01/1908
090015	94842	CAPE OTWAY LIGHTHOUSE	012 / / / / NN	01/05/1862
091057	94965	LOW HEAD	012 / / / / NN	/ /1882
092003	95989	BICHENO	01210/07/1990 / / NN	/ /1917
092045	94983	EDDYSTONE POINT	012 / / / / NN	/ /1908
092094		SCAMANDER	012 / / / /1990NN	/ /1974
094010	94967	CAPE BRUNY	012 / / / / NN	/ /1871
094041	94962	MAATSUYKER ISLAND	012 / / / / NN	/ /1891
094166	95975	BULL BAY	012 / / / / NN	22/08/1983
099001	95965	DEAL ISLAND	012 / / / / NN	/ /1871
200283	94299	WILLIS ISLAND M.O.	012 / / / / NN	/ /1921
200602		ASHMORE REEF	01207/10/198512/03/1993NN	/ /1962
200845	95287	NORMAN REEF	012 / /1993 / / NN	16/07/1993
200846	95290	MOORE REEF	012 / /1993 / / NN	16/07/1993

Positions of Black Point; Mt Barker; Miami and Rainbow Beaches (Gold Coast, Queensland); Ashmore, Moore and Norman Reefs (Great Barrier Reef); Griffith CSIRO; and Willis Island (Coral Sea) are not shown in Fig 5.1.3.

```
CLOSEDATE  PURPR

/ /      Non-telegraphic rainfall
14/12/1987    / /      Aeronautical
22/05/1987
/ /      Synoptic
/ /      Synoptic
/ /      Synoptic
/ /      Non-telegraphic rainfall
07/02/1991
/ /      Non-telegraphic rainfall
/ /      Synoptic
/ /      Synoptic
/ /      Synoptic
/ /      Synoptic
/ /      Non-telegraphic rainfall
/ /      Synoptic
/ /      Synoptic
/ /      Unclassified
/ /      Synoptic
/ /      Synoptic
28/02/1993
/ /      Synoptic
12/03/1991
/ /      Synoptic
/ /      Synoptic, upper air, aero
/ /      Non-telegraphic rainfall
/ /      Synoptic
/ /      Synoptic
/ /      Synoptic
/ /1978
/ /      Synoptic
/ /      Synoptic
/ /      Synoptic
/ /      Synoptic
/ /      Synoptic
/ /      Synoptic
/ /      Synoptic
/ /      Synoptic
/ /      Synoptic
/ /      Pluv, non-teleg rain
30/06/1989
/ /      Synoptic
/ /      Synoptic
/ /      Synoptic
/ /      Synoptic
/ /      Public information
/ /      Public information
/ /      Public information
/ /      Public information
/ /      Public information
/ /      Climate
/ /      Synoptic
/ /      Synoptic
/ /      Synoptic
/ /      Synoptic
/ /      Synoptic
08/07/1990
/ /      Synoptic
/ /      Synoptic
/ /      Synoptic
/ /      Synoptic
/ /      Synoptic, upper air
/ /1985
/ /      Synoptic
/ /      Synoptic
```

Siteno	Primary Name	Lat.	Long.
003004	BROOME	16.23.50 S	122.55.35 E
004090	KARRATHA	19.35.08 S	116.08.12 E
008282	ABROLHOS ISLANDS	28.42.58 S	113.47.05 E
009038	ROTTNEST	32.00.32 S	115.30.08 E
009518	AUGUSTA	34.22.27 S	115.07.48 E
009519	BUSSELTON	33.32.17 S	115.01.06 E
009875	MOUNT BARKER	34.34.21 S	117.36.46 E
014008	CAPE DON LIGHTSTATION	11.19.00 S	131.46.00 E
014011	MINJILANG	11.08.42 S	132.33.48 E
014153	BLACK POINT	11.09.24 S	132.08.36 E
014504	ELCHO ISLAND	12.01.50 S	135.33.49 E
018070	PORT LINCOLN	34.43.19 S	135.51.21 E
018115	NEPTUNE ISLAND	35.20.17 S	136.06.58 E
022029	ALTHORPE ISLAND	35.22.21 S	136.51.34 E
022801	CAPE BORDA	35.45.14 S	136.35.34 E
022803	CAPE WILLOUGHBY	35.50.36 S	138.07.53 E
022833	CAPE DE COUEDIC/SEATEMP	36.06. S	136.44. E
026005	CAPE NORTHUMBERLAND	38.03.33 S	140.40.16 E
026026	ROBE	37.09.52 S	139.45.16 E
027022	THURSDAY ISLAND MO	10.35.07 S	142.12.36 E
031037	LOW ISLES	16.23.03 S	145.33.33 E
031084	FITZROY ISLAND	16.55.36 S	146.00.12 E
032004	CARDWELL	18.15.29 S	146.01.14 E
033119	MACKAY	21.07.06 S	149.12.54 E
033138	MACKAY	20.48.06 S	149.16.30 E
039059	LADY ELLIOTT ISLAND LIGHTHOUSE	24.06.57 S	152.42.38 E
039085	SANDY CAPE	24.43.53 S	153.12.27 E
040043	CAPE MORETON	27.01.58 S	153.27.54 E
040660	MIAMI	28.04.24 S	153.26.57 E
040856	RAINBOW BEACH	25.54.03 S	153.05.20 E
058009	CAPE BYRON	28.38.27 S	153.38.05 E
058012	YAMBA	29.26.00 S	153.21.48 E
059030	SMOKY CAPE LIGHTHOUSE	30.55.28 S	153.05.10 E
061055	NEWCASTLE	32.55.12 S	151.47.52 E
061273	NORAH HEAD	33.16.58 S	151.34.30 E
068034	JERVIS BAY	35.05.44 S	150.48.13 E
069017	MONTAGUE ISLAND LIGHTHOUSE	36.15.18 S	150.13.30 E
069018	MORUYA HEADS	35.54.39 S	150.09.07 E
069055	GREEN CAPE	37.15.47 S	150.02.55 E
075028	GRIFFITH CSIRO	34.19.06 S	146.04.00 E
084016	GABO ISLAND	37.34.11 S	149.54.53 E
084070	POINT HICKS LIGHTHOUSE	37.48.13 S	149.16.25 E
084083	LAKES ENTRANCE	37.52.19 S	147.59.40 E
085096	WILSONS PROMONTORY LIGHTHOUSE	39.07.54 S	146.25.24 E
085258	BARRACOUTA	38.18.00 S	147.41.00 E
085259	HALIBUT	38.24.22 S	148.19.16 E
085260	MARLIN	38.13.56 S	148.13.16 E
085261	KINGFISH A	38.35.54 S	148.08.41 E
085262	KINGFISH B	38.35.59 S	148.11.20 E
086017	CAPE SCHANCK	38.29.35 S	144.53.09 E
090014	CAPE NELSON	38.25.55 S	141.32.31 E
090015	CAPE OTWAY LIGHTHOUSE	38.51.30 S	143.30.45 E
091057	LOW HEAD	41.03.24 S	146.47.18 E
092003	BICHENO	41.52.27 S	148.18.06 E
092045	EDDYSTONE POINT	40.59.36 S	148.20.48 E
092094	SCAMANDER	41.27.15 S	148.16.42 E
094010	CAPE BRUNY	43.29.25 S	147.08.41 E
094041	MAATSUYKER ISLAND	43.39.28 S	146.16.16 E
094166	BULL BAY	43.05.32 S	147.21.38 E
099001	DEAL ISLAND	39.28.35 S	147.18.55 E
200283	WILLIS ISLAND M O	16.18. S	149.59. E
200602	ASHMORE REEF	12.14.00 S	123.01.00 E
200845	NORMAN REEF	16.25.34 S	145.59.30 E
200846	MOORE REEF	16.51.21 S	146.13.54 E

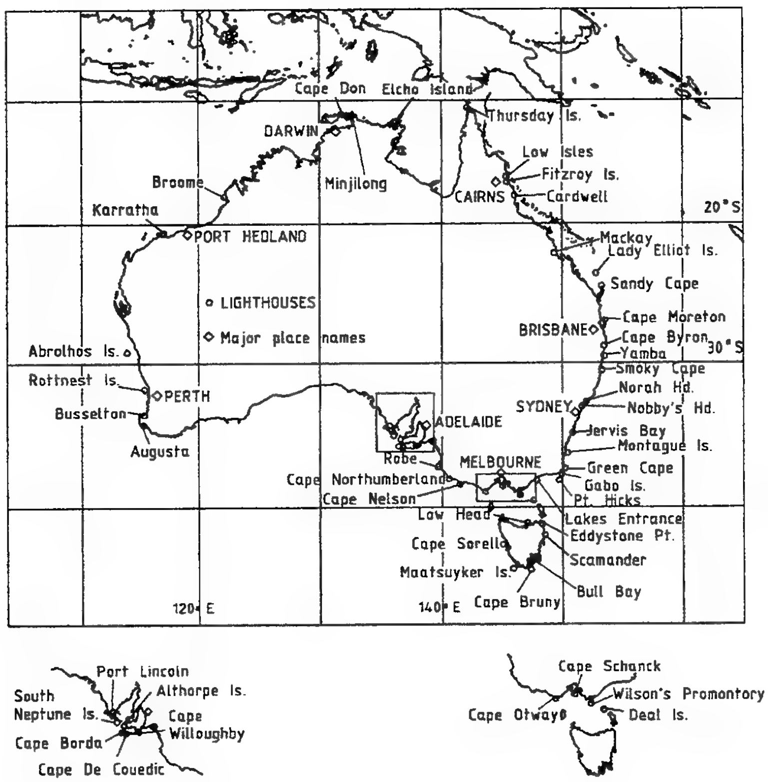

Fig. 5.1.3a. Locations of lighthouses which reported visual observations of sea and swell. Information from the Bureau of Meteorology.

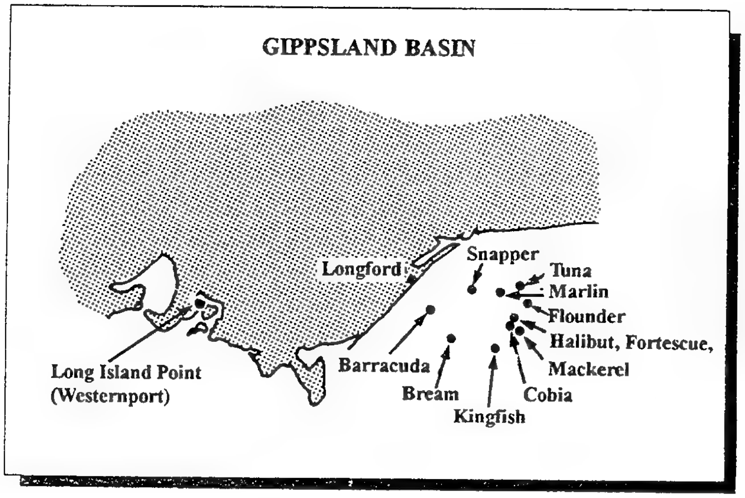

Fig. 5.1.3b. Locations of Bass Strait sites which reported visual observations of sea and swell (Barracouta, Halibut, Kingfish A, Kingfish B, Marlin). Information from the Bureau of Meteorology.

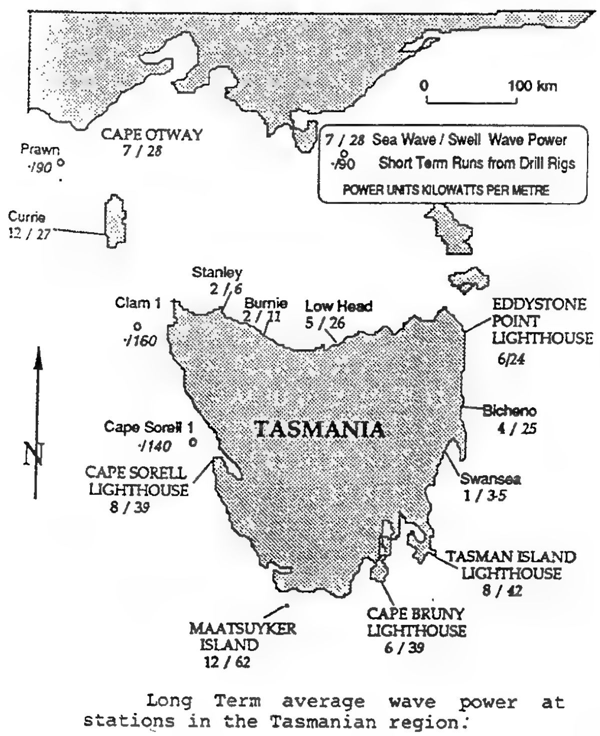

Fig. 5.1.3c. Locations of lighthouses around Tasmania (Underwood 1987).

5.2 Queensland

The **Beach Protection Authority of Queensland** provided details and charts of waverider locations and visual observations sites in their annual reports to 1989 (see Fig 5.2 and Table 4.2). The MIAS catalogue references data held by other bodies such as the Department Of Housing and Construction A.C.T., now the Department of Administrative Services (Moreton Bay); Dept Of Civil Engineering, University Of Queensland (Moffat Beach - Caloundra); Dept Of Geography, James Cook University (Bushy Island and Three Isles); Rendel, Scott and Furphy (Hay Point); Dept Of Harbours and Marine (Abbot Point); Townsville Harbour Board (Cape Cleveland). According to McGrath and Patterson (1973), lighthouse observations for Gold Coast sites Cape Moreton and Cape Byron are discussed in the report by Delft Hydraulics Laboratory (1970).

LIST OF SELECTED ARCHIVED WAVE DATA SITES - Queensland

Note that a listing in this document for data or reports does not necessarily mean that the data or reports are available for public use or perusal, or that data or reports are free of charge. Requests for data or information should not be made to DSTO, but directly to the organisations which gathered the data.

1. Symbols used:
* = entries from the MIAS Catalogue Of Wave Data (1982).
^ = update to MIAS obtained in 1995 from BODC
A = AIMS (Townsville)
B = Beach Protection Authority Queensland Annual Report 1989
L = Lawson & Treloar
P = Port of Brisbane Corporation
Z = WNI Science & Engineering

2. MIAS (1982) and Beach Protection Authority Queensland Annual Report 1989 show different positions by one minute (1') to five minutes (5') of latitude or longitude. It is not known if the positions have been revised, if more than one buoy were near the position, or if positions changed after services of the buoy.

2. Numbers in brackets after place names are position numbers assigned by the BPA.

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QUEENSLAND (clockwise from Gulf of Carpentaria)
SEE APPENDIX I FOR AN ALPHABETICAL LISTING OF ALL SITES KNOWN TO HAVE WAVE DETAILS

L 17 06     S 139 45    E; Gulf of Carpentaria; 00/07/91-00/07/92; 12 m
-           S           E; Rocky Point, Gove; 00/12/64-00/08/65; BOM (1966)
B           S           E; Karumba (31); 01/08/94-31/05/95
B           S           E; Karumba (32); 04/08/94-20/01/95
B 12 40 50  S 141 45 12 E; Weipa (18); 21/12/78-99/99/99
Z 14.6067   S 145.6050  E; Yonge Reef; 19/08/85-19/09/85
* 15 07     S 145 24    E; Three Isles; 02/07/76-06/07/76
* 16 48     S 145 45    E; Cairns (09); 02/05/75-99/99/99
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* 16 48    S 145 45    E; Cairns Holloway Beach (21); 19/03/81-12/07/82; BPA
B 17 19 50 S 146 02 12 E; Bramston Beach (22); 16/12/81-30/10/85
A 18 18    S 147 18    E; Myrmidon Reef; 09/03/92-23/03/92; 50 m; + S4, gauge, pr
A 18 48    S 147 31.8  E; Wheeler Reef; 03/11/93-25/11/93; 50 m; + S4s, gauge, pr
A 18 48    S 147 31.8  E; Wheeler Reef; 27/02/94-14/04/94; 50 m; + S4s, gauge, pr
A 18 48    S 147 31.8  E; Wheeler Reef; 18/10/95-04/12/95; 50 m; + S4s, gauge, pr
B          S           E; Lucinda (33); 02/03/95-99/99/99
Z 19.0517  S 148.6812  E; Leopard Reef; 22/02/89-04/05/89;
B 19 08    S 146 39    E; Yabulu (30); 20/01/86-14/04/87
* 19 09    S 147 03    E; Cape Cleveland; 16/07/75-?
* 19 09    S 147 01    E; Townsville; 16/07/75-?
B          S           E; Townsville (10); 20/11/75-99/99/99
* 19 14    S 146 51    E; Townsville Breakwater; 15/01/81-?
B 19 51    S 148 05    E; Abbot Point; 04/08/81-?
* 19 52    S 148 06    E; Abbot Point (16); 22/04/77-99/99/99
* 19 55    S 148 17    E; Bowen (17); 14/09/78-29/05/86
* 20 57    S 150 03    E; Bushy Island; 01/07/74-05/07/74
B          S           E; Repulse Bay (45); 02/06/94-99/99/99
B 21 00    S 149 01    E; Mackay inshore (41); 12/05/87-06/05/88
B 21 03    S 149 33    E; Mackay; 24/11/77-?
* 21 06    S 149 32    E; Mackay (11); 17/09/75-99/99/99
* 21 06    S 149 32    E; Mackay; 24/11/77-?
B 21 07    S 149 14    E; Mackay inshore(40); 11/03/86-07/04/87
B          S           E; Mackay (42); 10/02/88-11/05/89
B          S           E; Mackay (43); 06/02/90-18/02/91
* 21 16    S 149 20    E; Hay Point; 00/06/69-00/03/70
* 21 19    S 149 23    E; Hay Point (Highwater Inlet)(15); 22/03/77-99/99/99
* 23 07    S 151 04    E; Yeppoon (08); 19/12/74-16/03/78
A 23 09.6  S 150 45    E; Farnborough; 07/02/93-11/02/93; S4 at various depths
A 23 09.6  S 150 45    E; Farnborough; 22/05/94-28/05/94; S4 at various depths
B 23 10    S 150 47    E; Rosslyn Bay (inshore) (24); 13/02/87-13/04/87
B 23 06    S 150 56    E; Rosslyn Bay (offshore)(25); 21/02/87-20/04/87; 18 m; pr
B 23 55    S 151 34    E; Gladstone (56); 18/12/79-19/05/83
* 24 24    S 152 35    E; Burnett Heads (12); 05/05/76-04/10/90
B 24 43    S 152 17    E; Moore Park (73); 19/02/86-04/08/86
B 24 50    S 152 28    E; Bargara (74); 19/02/86-04/08/86
B 24 59    S 152 30    E; Coonarr (75); 19/02/86-04/08/86
B 25 06    S 152 34    E; Woodgate (72); 05/09/85-11/02/86
B 25 14    S 152 42    E; Toogoom (71); 03/05/85-05/09/85
* 25 15    S 152 51    E; Hervey Bay (14); 02/03/77-13/02/86
* 26 01    S 153 17    E; Double Island Point; 05/04/74-05/07/77
* 26 23    S 153 08    E; Noosa Heads (20); 11/09/80-22/01/81
* 26 23    S 153 05    E; Noosa Heads (19); 11/09/80-02/07/81
B 26 23    S 153 05    E; Noosa (26); 09/02/89-21/08/92
* 26 47 30 S 153 09 30 E; Moffat Beach, Caloundra; 17/01/63-21/06/63
* 26 47 30 S 153 09 30 E; Moffat Beach, Caloundra; 20/11/63-21/04/64
B          S           E; Bribie Island (99); 15/06/83-12/04/85
P 26 51 14 S 153 08 55 E; Bribie Island; 25/06/96-99/99/99; wave pole
P 26 51 34 S 153 09 14 E; Bribie Island; 28/06/96-99/99/99; wave pole
B 26 58    S 153 21    E; Moreton Island; 01/06/83-12/04/85; 20 m; pr
B 27 04    S 153 12    E; Woorim (70); 22/09/88-99/99/99
L 27 12 34 S 153 20 45 E; Ridge Shoal, Moreton Bay; 15/10/80-11/10/84; 10 m
* 27 23    S 153 35    E; Brisbane (Point Lookout) (13); 31/10/76-99/99/99
- 27 29.55 S 153 37.33 E; North Stradbroke Island (Lookout Point); ?/?/96-
B 27 56    S 153 29    E; Nerang River (98); 12/07/84-09/05/86
* 27 57    S 153 30    E; Southport; 01/08/68-15/03/69
B 27 58    S 153 26    E; Gold Coast (The Spit) (23); 20/02/87-99/99/99
* 28 03    S 153 32    E; South Nobby; 01/08/68-01/08/76
* 28 06    S 153 33    E; Danger Point, Queensland; 01/08/68-07/02/70
B 28 09    S 153 31    E; Gold Coast (Kirra) (27); 25/08/88-99/99/99
* 28 10    S 153 32    E; Kirra Pt; 16/05/72-27/06/73
B          S           E; Tweed Heads (28); 13/01/95-99/99/99
* 28 38 30 S 153 41 18 E; Cape Byron; 14/10/76-?
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Other locations: Agincourt Reef No. 3, Green Island, John Brewer Reef, Norman Reef. See section 3.1.3 for details.

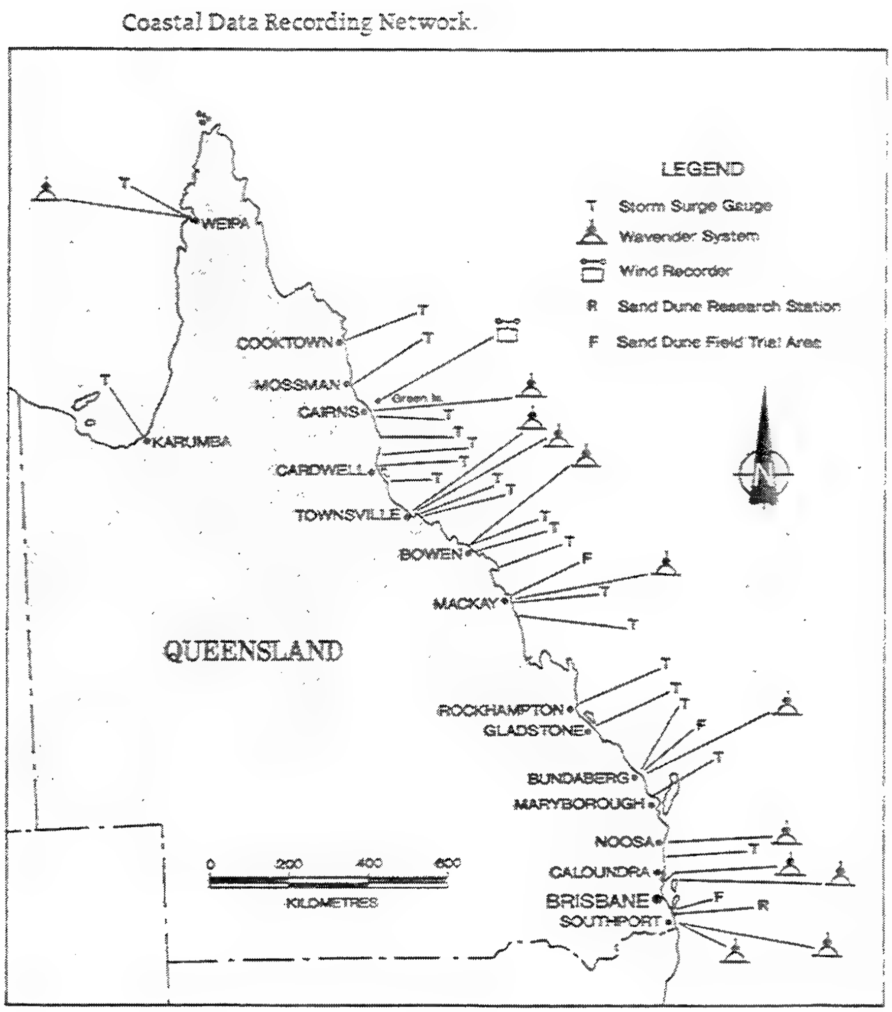


Fig. 5.2. Queensland coastal data recording network operated by the Beach Protection Authority of Queensland.

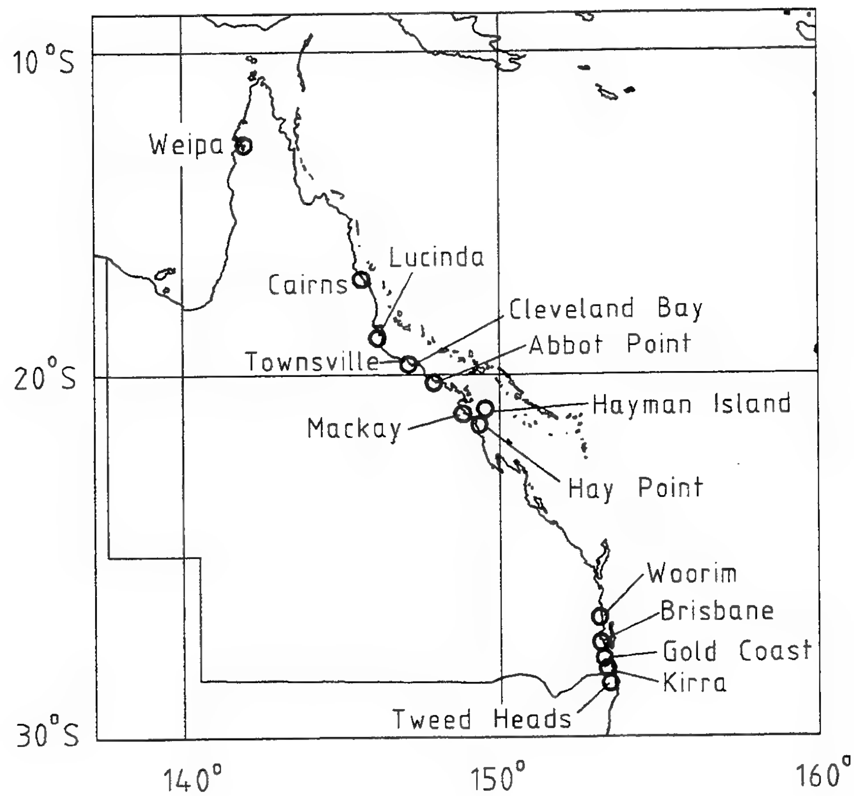
LIST OF PAST AND PRESENT WAVE STATIONS PROVIDED BY THE BEACH PROTECTION AUTHORITY IN 1995

Table 1.0 - List of Past and Present Wave Recording Stations

Station	No	Start Date	End Date	
Abbot Point	16	07/05/1977 03:00	30/04/1995 23:00	*
Bargarra	74	18/02/1986 12:54	10/04/1986 18:01	
Bowen	17	14/09/1978 15:00	29/05/1986 02:50	
Bramstone Beach	22	16/12/1981 15:00	28/10/1985 09:17	
Bribie Island	99	15/06/1983 15:00	12/04/1985 03:00	
Brisbane	13	30/10/197615:00	31/05/1995 23:00	*
Burnett Heads	12	05/05/1976 15:00	04/10/1990 03:08	
Cairns	09	03/05/1975 03:00	31/05/1995 23:00	*
Cairns	21	18/03/1981 15:00	12/07/1982 09:00	
Coonarr	75	18/02/1986 13:13	04/08/1986 14:40	
Gladstone	56	19/12/1979 15:00	16/05/1983 21:00	
Gold Coast	23	20/02/1987 20:53	31/05/1995 23:00	*
Hay Point	15	23/03/1977 03:00	31/05/1995 23:30	*
Hervey Bay	14	03/03/1977 03:00	13/02/1986 09:00	
Karumba	31	01/08/1994 01:00	31/05/1995 16:00	
Karumba	32	04/08/1994 13:30	20/01/1995 00:00	
Kirra	27	25/08/1988 20:50	31/05/1995 23:00	*
Lucinda	33	02/03/1995 10:00	31/05/1995 23:00	*
Mackay	11	18/09/1975 03:00	31/05/1995 23:00	*
Mackay	40	11/03/1986 15:07	07/04/1987 03:08	
Mackay	41	12/05/1987 21:15	06/05/1988 03:17	
Mackay	42	10/02/1988 14:59	11/05/1989 02:58	
Mackay	43	06/02/1990 15:07	18/02/1991 09:57	
Moore Park	73	18/02/1986 12:45	04/08/1986 09:11	
Nerang	98	13/07/1984 21:00	09/05/1986 08:47	
Noosa	19	14/11/1980 09:00	21/06/1981 03:00	
Noosa	20	14/11/1980 09:00	22/01/1981 09:00	
Noosa	26	09/02/1989 14:55	21/08/1992 08:59	
Repulse Bay	45	02/06/1994 01:00	31/05/1995 23:00	*
Rosslyn Bay	24	13/02/1987 14:50	13/04/1987 08:49	
Rosslyn Bay	25	21/02/1987 14:59	20/04/1987 21:19	
Toogoom	71	01/05/1985 18:00	05/09/1985 06:00	
Townsville	10	20/11/1975 03:00	31/05/1995 23:00	*
Tweed Heads	28	13/01/1995 12:00	31/05/1995 23:00	*
Weipa	18	22/12/1978 03:00	31/05/1995 23:00	*
Woodgate	72	05/09/1985 18:00	11/02/1986 23:05	
Woorim	70	23/09/1988 17:05	31/05/1995 23:00	*
Yabulu	30	19/03/1986 14:39	14/04/1987 09:09	
Yeppoon	08	19/12/1974 15:00	06/03/1978 15:00	

* Denotes station currently active

Location of Beach Protection Authority Wave Recorders
Active at end of October 1995



Operating Wave Recording Stations (as at June 30, 1989)

STATION	LOCATION OF BUOY Latitude	Longitude	Description	Date of Installation	Date of Closure	Remarks
Gold Coast (The Spit)	27°58'	153°26'	1.2 km off Sheraton Mirage Hotel (The Spit)	20-2-87		Jointly operated by Gold Coast City Council and BPA
Gold Coast (Kirra)	28°09'	153°31'	1.5 km offshore from Kirra Point	25-08-88		Operated by Gold Coast City Council
Brisbane	27°24'	153°36'	7 km N of Point Lookout	31-10-76		Report W09.1 available for data 30-10-76 to 30-06-83
Woorim	27°04'	153°12'	200 m offshore from Woorim Beach	22-09-88		
Noosa	26°23'	153°05'	120 m offshore from Main Beach	09-02-89		
Burnett Heads	24°32'	152°35'	36 km NNE of Burnett Heads	05-05-76		Report W05.1 available for data 05-05-76 to 05-03-82
Mackay	21°03'	149°33'	33 km NE of Mackaey Harbour	17-09-75 24-11-77	05-11-76	Report W02.2 available for data 17-09-75 to 05-11-76 and 24-11-77 to 23-8-85
Abbot Point	19°51'	148°05'	3.6 km NNE of Abbot Point	06-05-77 04-08-81	30-08-79	Report W06.1 available for data 06-05-77 to 09-08-79
Townsville	19°10'	147°04'	6 km NE of Cape Cleveland	16-07-75		Report W03.1 available for data 16-07-75 to 23-02-79 Report W03.2 available for data 16-07-75 to 29-12-87
Townsville Harbour	19°15'	146°51'	Off eastern breakwater to main harbour	15-01-81		Owned by Townsville Port Authority. Data recorded on pen chart only
Cairns	16°43'	145°42'	2.5 km NE of Double Island	02-05-75		Report WO1.2 available for data 02-05-75 to 11-06-85. Data also published in "Mulgrave Shire Northern Beaches" Report
Weipa	12°41'	141°45'	11 km W of Lorim Point	21-12-78		Owned by Department of Harbours and Marine (Property Management Division). Report WO7.1 available for data 21-12-78 to 07-04-83

Table 5.2. Details of operating wave recording stations off Queensland as at June 30, 1989 (Annual Report Beach Protection Authority 1989).

Closed Wave Recording Stations

STATION	LOCATION OF BUOY Latitude	Longitude	Description	Date of Installation	Date of Closure	Remarks
Gold Coast	28°06′	153°33′	8.3 km N of Point Danger	01-08-68	07-02-70	
	28°03′	153°32′	9.3 km ENE of South Nobby	01-08-68	01-08-76	
	27°57′	153°30′	7.5 km NE of Southport	01-08-68	15-03-69	
	28°10′	153°32′	600 m NE of Kirra Point	16-05-72	27-06-73	
Nerang River Entrance	27°56′	153°29′	1.8 km E Nerang River Entrance	12-07-84	09-05-86	Operated for Leighton-Candac Nerang Pty Ltd.
Moreton Island (North East Shipping Channel)	26°58′	153°21′	10.5 km NNW of Comboyuro Point	01-06-83	12-04-85	Operated for Port of Brisbane Authority Report W11.1 available for data 15-06-83 to 12-04-85
Noosa Beach	26°23′	153°05′	300 m off Noosa Beach	11-09-80	02-07-81	
Noosa Heads	26°23′	153°08′	2 km ENE of Noosa Heads	11-09-80	22-01-81	
Sunshine Coast	26°01′	153°17′	14 km SE of Double Island Point	05-04-74	05-07-77	Report W04.1 available for data 05-04-74 to 05-07-77
Hervey Bay	25°15′	152°51′	2 km E of Point Vernon	02-03-77	13-02-86	
Toogoom	25°14′	152°42′	2.6 km NNE of East Toogoom	03-05-85	05-09-85	
Woodgate	25°06′	152°34′	800 m off beach	05-09-85	11-02-86	
Coonarr	24°59′	152°30′	1 km off beach	19-02-86	04-08-86	
Bargara	24°50′	152°28′	100 m off rock wall	19-02-86	04-08-86	
Moore Park	24°43′	152°17′	1.2 km off beach	19-02-86	04-08-86	

Table 5.2b. Details of closed wave recording stations off Queensland (Annual Report Beach Protection Authority 1989).

Closed Wave Recording Stations

STATION	LOCATION OF BUOY Latitude	Longitude	Description	Date of Installation	Date of Closure	Remarks
Gladstone	23°55′	151°34′	32 km ESE of Gladstone	18-12-79	19-05-83	Operated for Gladstone Port Authority. Report W08.1 available for data 19-12-79 to 16-05-83
Yepoon	23°07′	151°04′	33 km E of Yepoon	19-12-74	16-03-78	Data published in "Capricorn Coast Beaches" Report
Rosslyn Bay (inshore)	23°10′	150°47′	6 km SE of Yeppoon	13-02-87	13-04-87	Operated for Department of Harbours and Marine
Rosslyn Bay (offshore)	23°05′	150°56′	19 km ENE of Yeppoon	21-02-87	20-04-87	Operated for Department of Harbours and Marine
Hay Point	21°19′	149°23′	8 km E of Highwater Islet	22-03-77	25-05-87	Owned by Department of Harbours and Marine
Mackay (inshore)	21°07′	149°14′	1 km S of Harbour Breakwater	11-03-86	07-04-87	
Mackay (inshore)	21°00′	149°01′	1 km off Blacks Beach	12-05-87	6-05-88	
Mackay (inshore)	21°00′	149°11′	1.8 km E of Shoal Point	23-05-88	12-05-89	
Bowen	19°56′	148°17′	20 km NE of Bowen	14-09-78	29-05-86	Report W10.1 available for data 14-09-78 to 14-11-84
Yabulu	19°08′	146°39′	4 km E of Halifax Bay	20-01-86	14-04-87	Operated for Qld Nickel Pty Ltd.
Bramston Beach	17°19′	146°02′	6 km NE of Bramston Beach	16-12-81	30-10-85	Operated for Qld Water Resources Commission
Cairns (inshore)	16°48′	145°45′	1.5 km off Holloways Beach	19-03-81	12-07-82	Data published in "Mulgrave Shire Northern Beaches"

Table 5.2c. Details of closed wave recording stations off Queensland (Annual Report Beach Protection Authority 1989).

5.3 New South Wales

The majority of information is available from the **Manly Hydraulics Laboratory** of the NSW Public Works and Services Department; the **Sydney Ports Corporation (SPC)**; and contractors such as **Lawson and Treloar**.

5.3.1 The **Manly Hydraulics Laboratory, NSW Public Works and Services Department** provide comprehensive details of their data listings and charts of waverider, pressure recorder, and current meter locations in their annual reports e.g. Fig 5.3. Seven waverider sites are shown: Byron Bay, Coffs Harbour, Crowdy Head, Sydney, Port Kembla, Batemans Bay, and Eden. Some earlier PWD data, and data for other sites such as Cronulla, Broken Bay, and Twofold Bay, are listed in the MIAS catalogue.

5.3.1.1 Water level data are sampled at 1 second intervals by PWD tide gauges, e.g. Zwarts poles, but some are sited in protected positions, as mentioned in section 3.2.1.1. Directional data are available from some of these sites which are also fitted with Marsh-McBirney current meters. See Kulmar (1995) for references to directional wave data sets for Sydney.

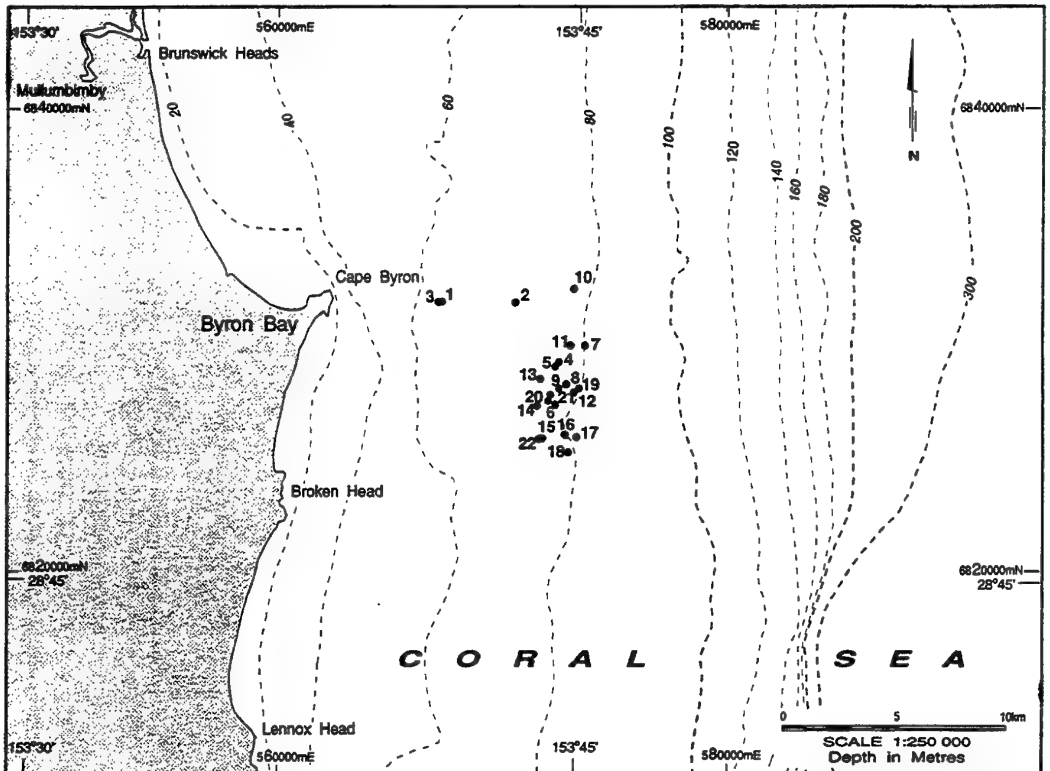
5.3.2 Other information is also available from the **Sydney Ports Corporation (SPC)**, previously of the Maritime Services Board (MSB). Positions occupied by the MSB in Botany Bay and off Newcastle are listed in MIAS (1982). Max Willoughby of the SPC has supplied more recent details (Fig 5.3.2). There are some disagreements in the MIAS and SPC information.

5.3.3 Information for Jervis Bay is summarised in Sinclair Knight and Partners (1989). See Fig 5.3.3 and Table 5.3.3.

5.3.4 Ray Rice supplied a listing of the wave data information held by the engineering contractors **Lawson and Treloar** for Australia (see section 6.2). NSW sites are Belmont, Jervis Bay (several sites), Port Kembla outer harbour (three sites), and Providential Head.

5.3.5 Visual observations of breaking wave height, period and direction were recorded at forty-six sites from 1979 to 1987 by the PWD **Coast and Rivers Branch** (see Fig 5.3.5, Table 5.3.5 and section 7.4.3). "The **Surf Environmental Analysis (SEA) Study programme** was initiated by the PWD in 1979 with the aim of acquiring surf environment and beach usage data from a large number of New South Wales beaches. In order to keep costs low it was decided to use volunteer observers with a minimum of supervision from the Department. Data collection continued at some sites to the end of 1987 providing nearly eight years of record while, at others, it was terminated as early as 1980. Data checking and synthesis into a compact and intelligible form was carried out by Lawson and Treloar Pty Ltd." Observations were made morning and afternoon. Wave height exceedance and directionality plots are shown in the reports. Breaking waves

were classified as spilling, plunging, surging, or spilling-plunging. Data were stored on magnetic tapes. See e.g. "Public Works Dept (1992). Surf environment analysis: North Sapphire Beach. NSW Coast and Rivers Branch. PWD report No. 92052". It is not known if any sites are still operational.



DEPLOYMENT LOCATION	LOCATION DETAILS Latitude (S)	Longitude (E)	AMG (Zone 56) Northing	Easting	WATER DEPTH (m)	DEPLOYMENT PERIOD 1st Date	Last Date
1	28°38'24"	153°41'18"	6831690	567280	64	14-Oct-76	07-Jun-78
2	28°38'24"	153°43'18"	6831670	570530	70	03-Aug-78	13-Jun-79
3	28°38'24"	153°41'12"	6831690	567110	62	08-Aug-79	09-Aug-83
4	28°39'48"	153°44'30"	6829080	572470	77	09-Aug-83	13-Dec-83
5	28°39'54"	153°44'24"	6828890	572310	77	07-Feb-84	25-Sep-84
6	28°40'48"	153°44'24"	6827230	572300	73	25-Sep-84	30-Jun-85
7	28°39'24"	153°45'12"	6829810	573620	80	27-Aug-85	22-Nov-85
8	28°40'18"	153°44'42"	6828140	572790	78	12-Dec-85	24-Mar-87
9	28°40'25"	153°44'31"	6827950	572480	78	24-Mar-87	19-Nov-87
10	28°38'05"	153°44'54"	6832250	573150	77	03-Dec-87	07-Apr-88
11	28°39'24"	153°44'49"	6829800	572980	77	18-May-88	07-Nov-88
12	28°40'30"	153°44'55"	6827780	573130	82	06-Dec-88	08-Dec-88
13	28°40'12"	153°44'00"	6828350	571650	72	10-Jan-89	05-Aug-89
14	28°40'49"	153°43'55"	6827200	571500	71	29-Aug-89	14-Dec-89
15	28°41'35"	153°44'03"	6825790	571730	74	07-Feb-90	06-Dec-90
16	28°41'30"	153°44'40"	6825950	572730	73	06-Dec-90	09-May-91
17	28°41'33"	153°44'59"	6825840	573240	78	29-May-91	14-May-92
18	28°41'55"	153°44'46"	6825170	572880	73	14-May-92	18-Jun-93
19	28°40'28"	153°44'26"	6827850	572360	73	23-Jun-93	21-Jul-93
20	28°40'46"	153°44'12"	6827300	571970	72	21-Jul-93	11-Nov-93
21	28°40'37"	153°44'15"	6827570	572060	72	01-Dec-93	20-Jul-94
22	28°41'36"	153°43'57"	6825760	571560	72	20-Jul-94	Present

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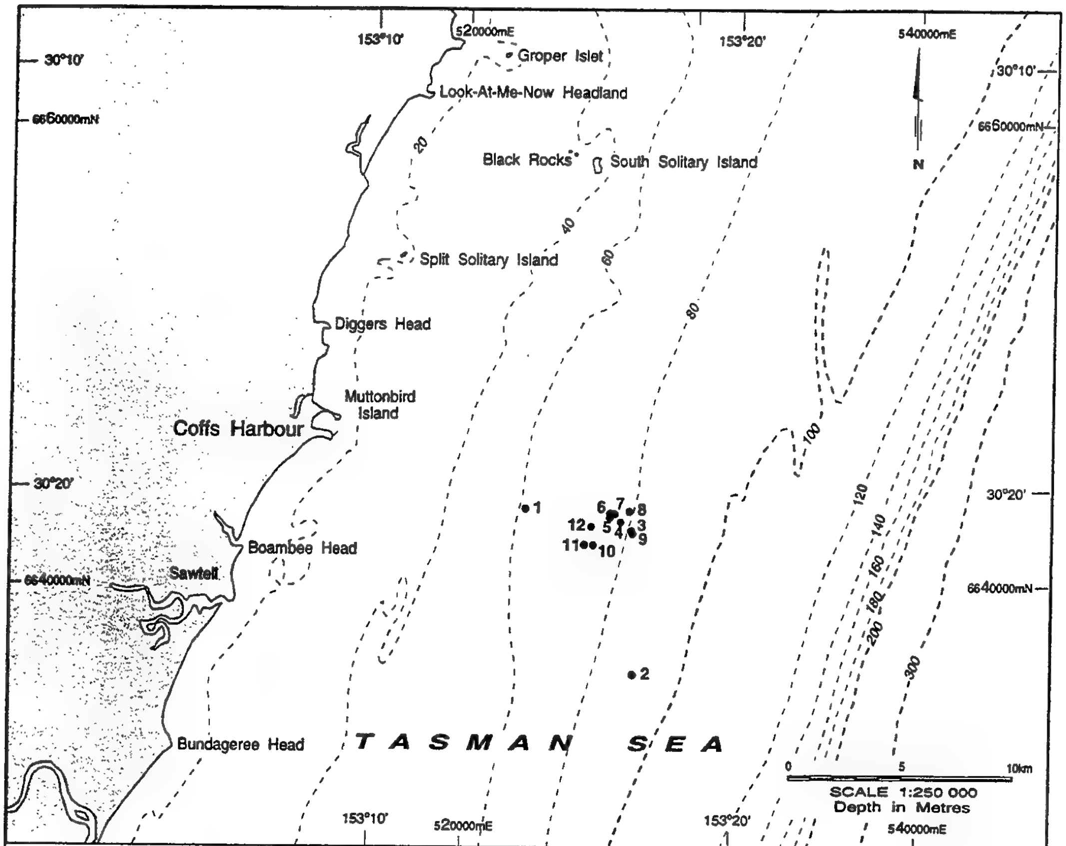
BYRON BAY WAVERIDER BUOY LOCATION HISTORY

Map 2

Fig. 5.3.1a. New South Wales Byron Bay waverider buoy location history (from Manly Hydraulics Laboratory report 733).



DEPLOYMENT LOCATION	LOCATION DETAILS Latitude (S)	Longitude (E)	AMG (Zone 56) Northing	Easting	WATER DEPTH (m)	DEPLOYMENT PERIOD 1st Date	Last Date
1	30°20'30"	153°14'12"	6643320	522750	60	26-May-76	18-Aug-83
2	30°24'18"	153°17'12"	6636290	527540	80	18-Aug-83	20-Dec-83
3	30°21'00"	153°17'06"	6642380	527390	80	20-Dec-83	07-Mar-84
4	30°20'48"	153°16'48"	6642760	526910	79	07-Mar-84	21-Mar-85
5	30°20'42"	153°16'30"	6642940	526430	77	12-Apr-85	09-Jul-85
6	30°20'36"	153°16'30"	6643130	526430	77	13-Aug-85	29-Oct-85
7	30°20'37"	153°16'38"	6643100	526640	77	05-Nov-85	08-Oct-87
8	30°20'34"	153°17'03"	6643200	527300	80	08-Oct-87	25-Sep-89
9	30°21'04"	153°17'08"	6642250	527450	82	25-Sep-89	06-Dec-89
10	30°21'21"	153°16'03"	6641750	525700	71	19-Dec-89	11-Apr-90
11	30°21'20"	153°15'48"	6641770	525300	73	11-Apr-90	22-Feb-91
12	30°20'55"	153°15'59"	6642550	525600	73	22-Feb-91	Present

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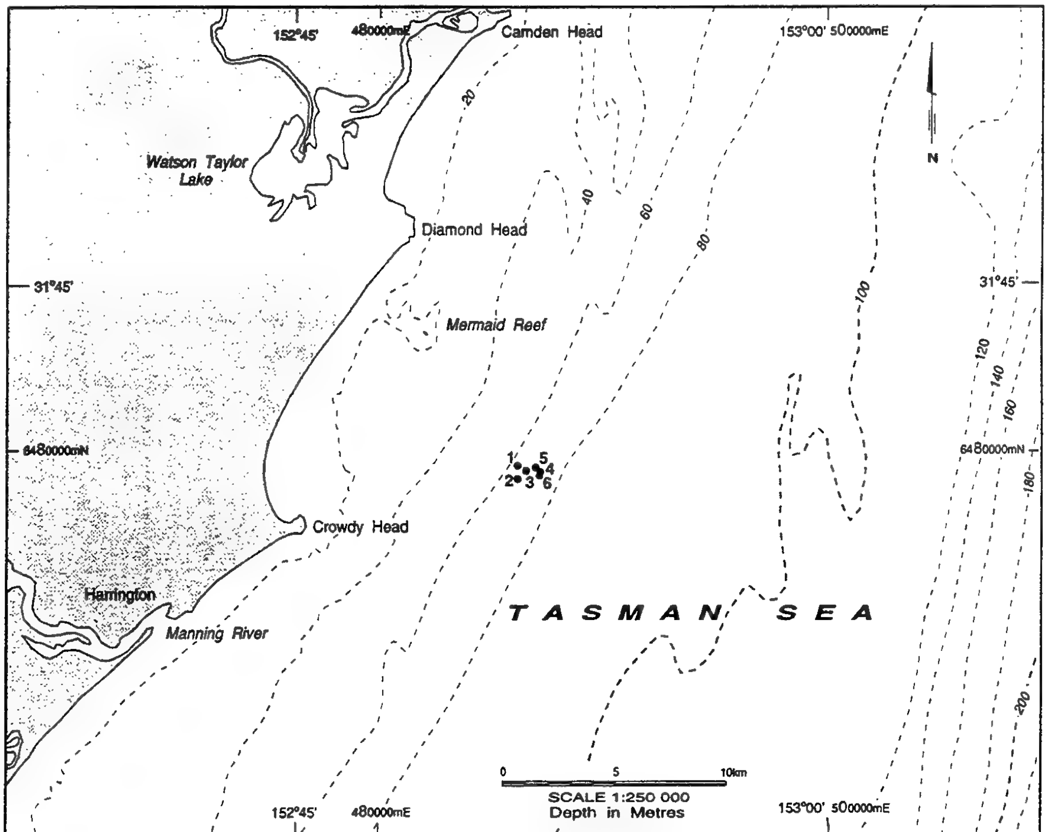
COFFS HARBOUR WAVERIDER BUOY LOCATION HISTORY

Map 3

Fig. 5.3.1b. New South Wales Coffs Harbour waverider buoy location history (from Manly Hydraulics Laboratory report 733).



DEPLOYMENT LOCATION	LOCATION DETAILS Latitude (S)	Longitude (E)	AMG (Zone 56) Northing	Easting	WATER DEPTH (m)	DEPLOYMENT PERIOD 1st Date	Last Date
1	31°49'37"	152°51'12"	6478730	486110	77	10-Oct-85	11-Nov-86
2	31°49'17"	152°51'12"	6479330	486110	77	11-Nov-86	20-Oct-87
3	31°49'25"	152°51'26"	6479100	486480	80	20-Oct-87	08-Aug-89
4	31°49'26"	152°51'49"	6479050	487100	79	08-Aug-89	17-Jul-90
5	31°49'20"	152°51'42"	6479250	486900	77	17-Jul-90	20-Apr-93
6	31°49'31"	152°51'47"	6478900	487050	79	20-Apr-93	Present

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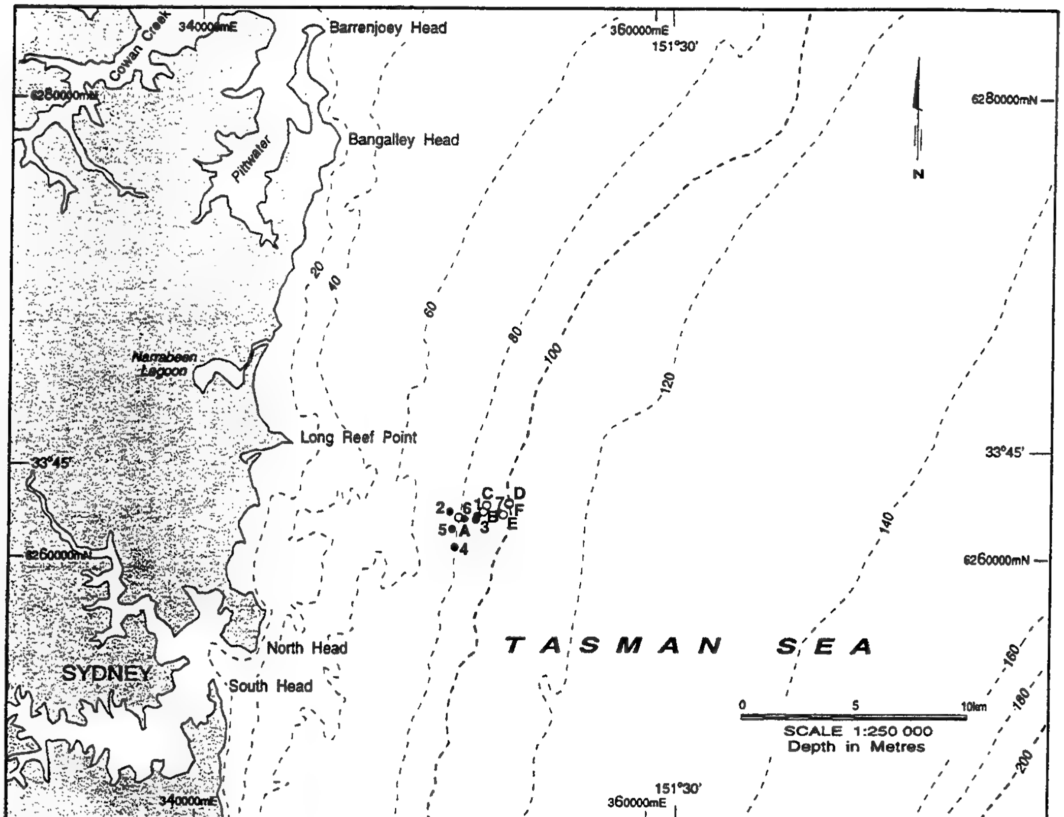
CROWDY HEAD WAVERIDER BUOY
LOCATION HISTORY

Map
4

Fig. 5.3.1c. New South Wales Crowdy Head waverider buoy location history (from Manly Hydraulics Laboratory report 733).



WAVERIDER BUOY LOCATION HISTORY

DEPLOYMENT LOCATION	LOCATION DETAILS Latitude (S)	Longitude (E)	AMG (Zone 56) Northing	Easting	WATER DEPTH (m)	DEPLOYMENT PERIOD 1st Date	Last Date
1	33°46'24"	151°24'24"	6261830	352460	90	17-Jul-87	22-Mar-88
2	33°46'18"	151°23'37"	6262000	351250	85	22-Mar-88	06-Jul-89
3	33°46'30"	151°24'22"	6261650	352400	85	06-Jul-89	02-May-90
4	33°47'08"	151°23'46"	6260450	351500	83	02-May-90	11-Jun-91
5	33°46'42"	151°23'40"	6261250	351350	84	26-Jun-91	23-Jan-92
6	33°46'28"	151°24'02"	6261700	351900	84	23-Jan-92	17-Nov-93
7	33°46'14"	151°24'56"	6262140	353280	85	17-Nov-93	Present

DIRECTIONAL WAVERIDER BUOY LOCATION HISTORY

DEPLOYMENT LOCATION	LOCATION DETAILS Latitude (S)	Longitude (E)	AMG (Zone 56) Northing	Easting	WATER DEPTH (m)	DEPLOYMENT PERIOD 1st Date	Last Date
A	33°46'26"	151°23'52"	6261750	351650	82	03-Mar-92	05-Apr-93
B	33°46'18"	151°24'35"	6262010	352740	85	22-Jun-93	17-Nov-93
C	33°46'04"	151°24'36"	6262440	352760	85	17-Nov-93	01-Dec-93
D	33°46'02"	151°25'13"	6262520	353710	85	18-Dec-93	16-Feb-94
E	33°46'17"	151°25'03"	6262050	353460	85	22-Mar-94	25-Feb-95
F	33°46'11"	151°25'18"	6262230	353840	87	25-Feb-95	Present

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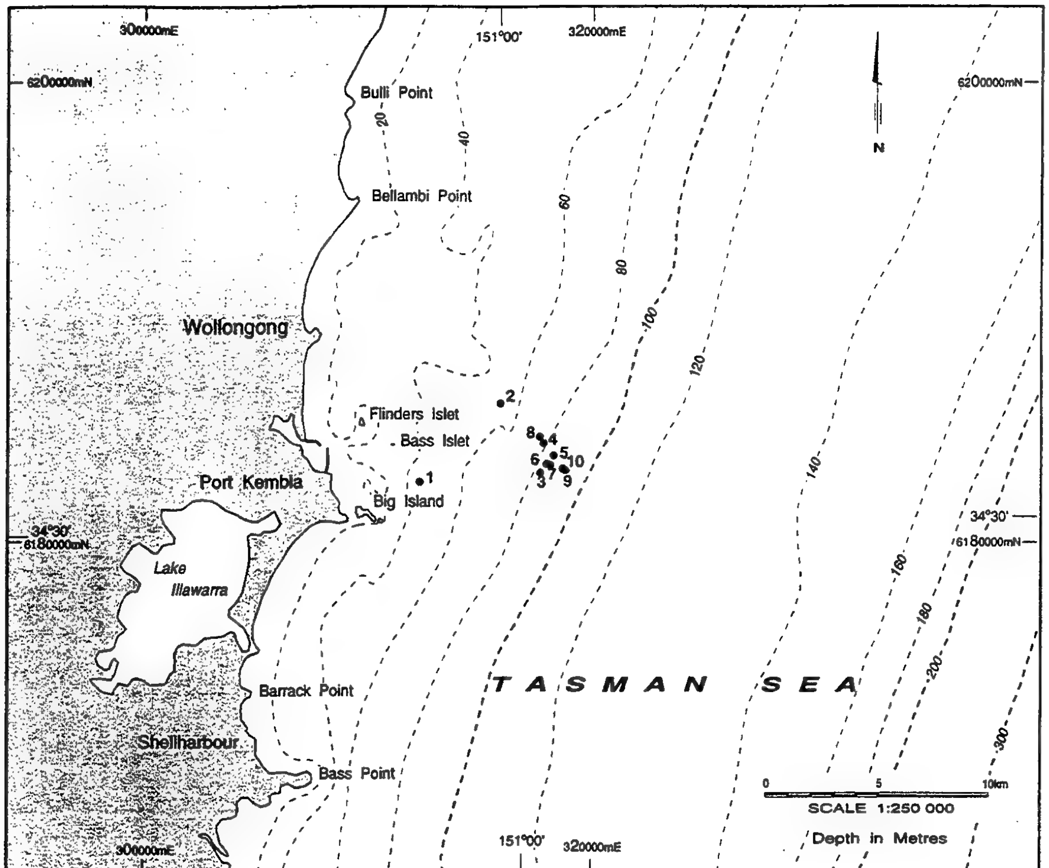
SYDNEY WAVERIDER BUOYS
LOCATION HISTORY

Map 5

Fig. 5.3.1d. New South Wales Sydney waverider buoy location history (from Manly Hydraulics Laboratory report 733).



DEPLOYMENT LOCATION	LOCATION DETAILS Latitude (S)	Longitude (E)	AMG (Zone 56) Northing	Easting	WATER DEPTH (m)	DEPLOYMENT PERIOD 1st Date	Last Date
1	34°28'52"	150°57'22"	6182590	312310	40	07-Feb-74	25-Oct-76
2	34°27'04"	150°59'47"	6185990	315940	50	25-Oct-76	16-Nov-83
3	34°28'42"	151°00'54"	6183000	317710	82	16-Nov-83	14-Jun-84
4	34°28'01"	151°01'00"	6184280	317850	76	14-Jun-84	27-May-88
5	34°28'18"	151°01'18"	6183750	318300	73	01-Jun-88	19-Dec-88
6	34°28'30"	151°01'06"	6183380	318000	73	19-Jan-89	25-Jan-90
7	34°28'32"	151°01'12"	6183330	318150	77	25-Jan-90	24-Oct-91
8	34°27'52"	151°00'55"	6184550	317700	82	24-Oct-91	24-Jun-92
9	34°28'24"	151°01'23"	6183090	318820	77	24-Jun-92	28-Jul-94
10	34°28'38"	151°01'31"	6183150	318650	78	28-Jul-94	Present

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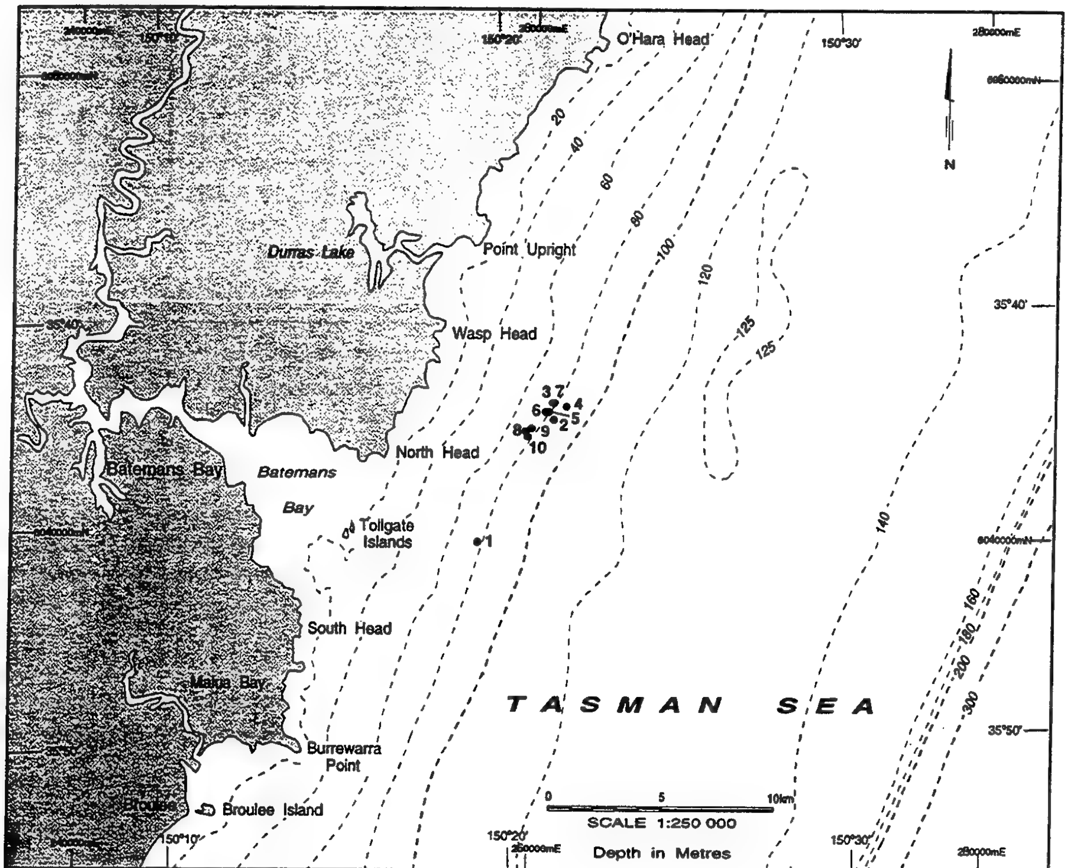
PORT KEMBLA WAVERIDER BUOY LOCATION HISTORY

Map 6

Fig. 5.3.1e. New South Wales Port Kembla waverider buoy location history (from Manly Hydraulics Laboratory report 733).



DEPLOYMENT LOCATION	LOCATION DETAILS Latitude (S)	Longitude (E)	AMG (Zone 56) Northing	Easting	WATER DEPTH (m)	DEPLOYMENT PERIOD 1st Date	Last Date
1	35°45'19"	150°19'11"	6039860	257650	79	27-May-86	02-Jun-86
2	35°42'29"	150°21'25"	6045200	260880	75	02-Jun-86	30-Sep-87
3	35°42'05"	150°21'24"	6045950	260850	75	01-Oct-87	29-Jun-88
4	35°42'12"	150°21'47"	6045750	261430	84	30-Jun-88	07-Feb-89
5	35°42'18"	150°21'18"	6045530	260700	80	07-Feb-89	19-Mar-89
6	35°42'18"	150°21'12"	6045530	260550	73	11-Apr-89	24-Oct-89
7	35°42'05"	150°21'26"	6045950	260900	75	25-Oct-89	09-Nov-89
8	35°42'44"	150°20'35"	6044700	259650	73	22-Nov-89	26-Apr-90
9	35°42'40"	150°20'47"	6044830	259950	73	09-May-90	19-Oct-90
10	35°42'52"	150°20'39"	6044450	259750	73	13-Nov-90	Present

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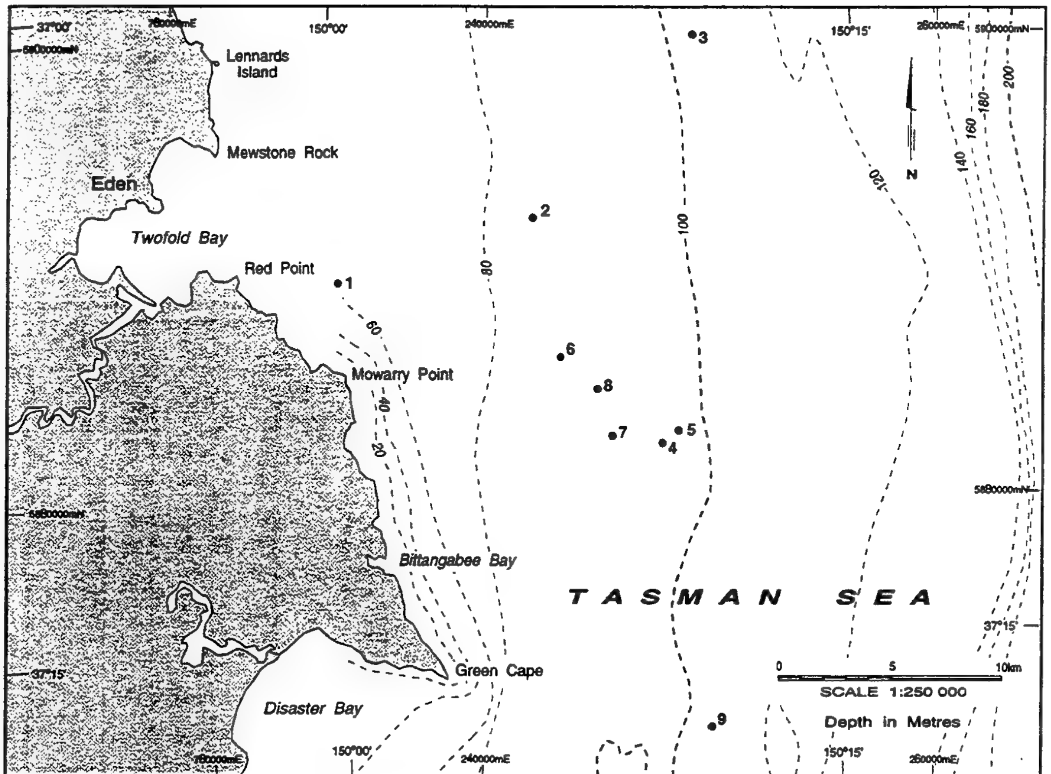
BATEMANS BAY WAVERIDER BUOY
LOCATION HISTORY

Map 7

Fig. 5.3.1f. New South Wales Batemans Bay waverider buoy location history (from Manly Hydraulics Laboratory report 733).



DEPLOYMENT LOCATION	LOCATION DETAILS Latitude (S)	Longitude (E)	AMG (Zone 56) Northing	Easting	WATER DEPTH (m)	DEPLOYMENT PERIOD 1st Date	2nd Date
1	37°06'36"	150°00'00"	5888700	233420	55	08-Feb-78	21-Sep-83
2	37°05'12"	150°05'48"	5891550	241930	79	21-Sep-83	22-Sep-84
3	37°01'00"	150°10'42"	5899540	248960	104	10-Oct-84	23-Oct-84
4	37°10'30"	150°09'30"	5881920	247710	86	21-Mar-85	15-Oct-86
5	37°10'13"	150°10'01"	5882450	248450	95	15-Oct-86	04-Feb-87
6	37°08'28"	150°06'30"	5885550	243150	80	04-Feb-87	10-Feb-87
7	37°10'18"	150°08'00"	5882220	245480	90	23-Apr-87	04-Feb-88
8	37°09'12"	150°07'35"	5884200	244800	90	04-Feb-88	07-Mar-89
9	37°17'12"	150°10'48"	5869580	250000	110	07-Mar-89	Present

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EDEN WAVERIDER BUOY
LOCATION HISTORY

Map 8

Fig. 5.3.1g. New South Wales Eden waverider buoy location history (from Manly Hydraulics Laboratory report 733).

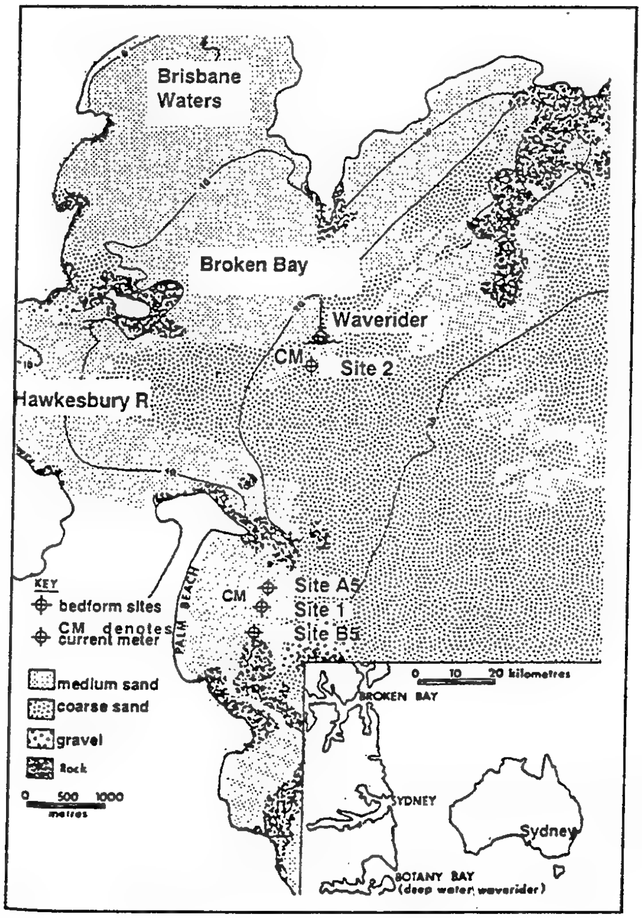

Fig. 5.3.1h. Broken Bay waverider buoy location (Nielsen and Lord 1989).

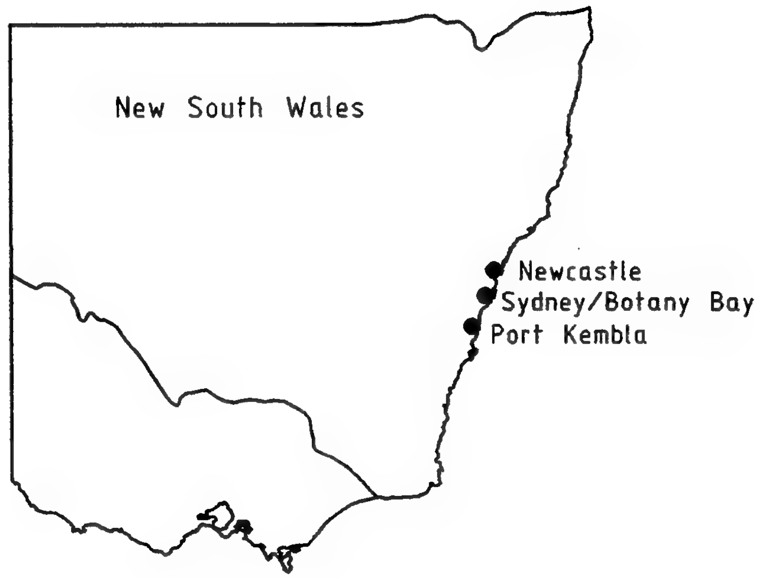

Fig. 5.3.2a. Newcastle, Botany Bay waverider buoy locations (Sydney Ports Authority)

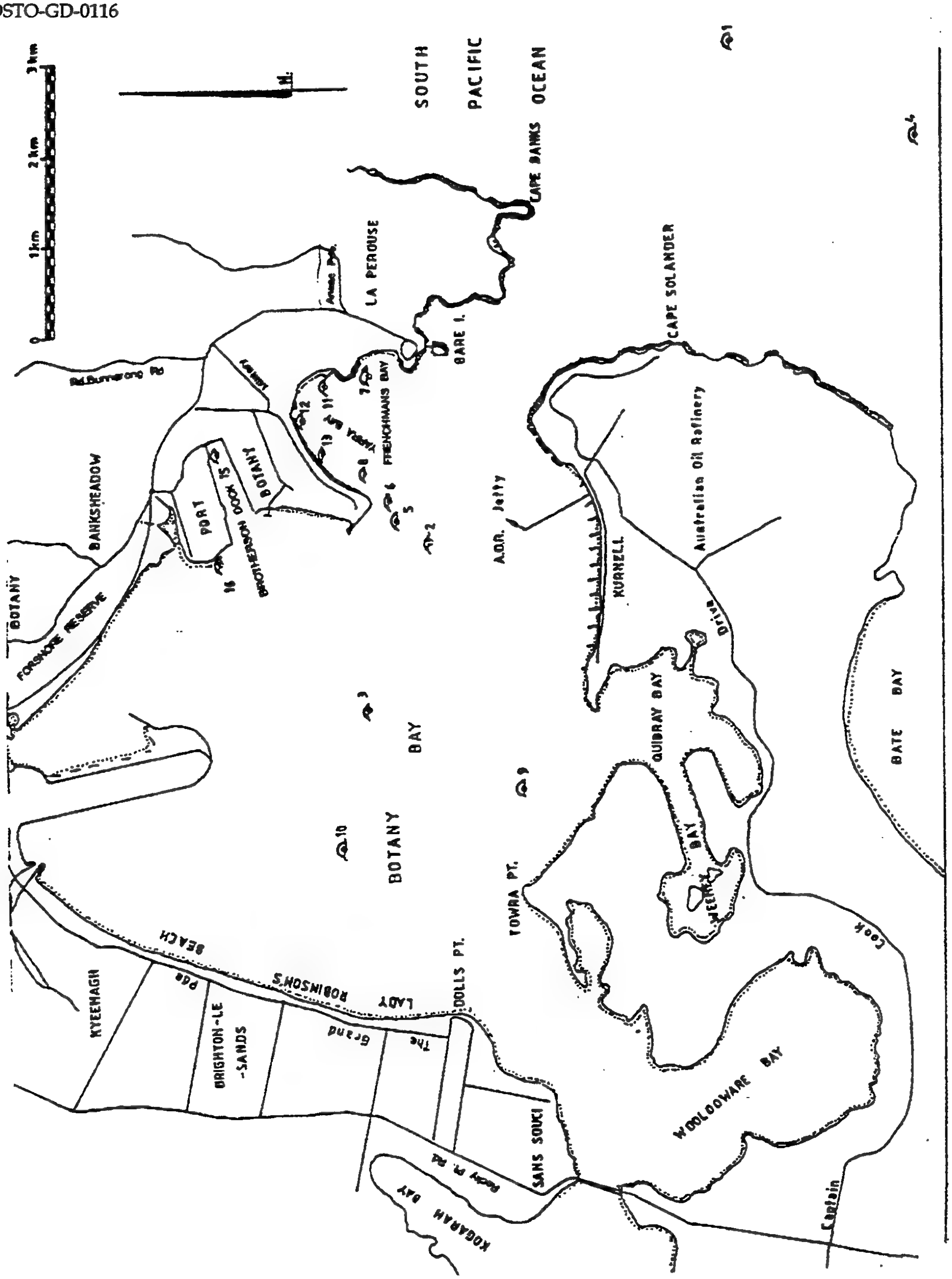

Fig 5.3.2b. New South Wales Botany Bay waverider buoy location history (information supplied by Sydney Ports Authority)

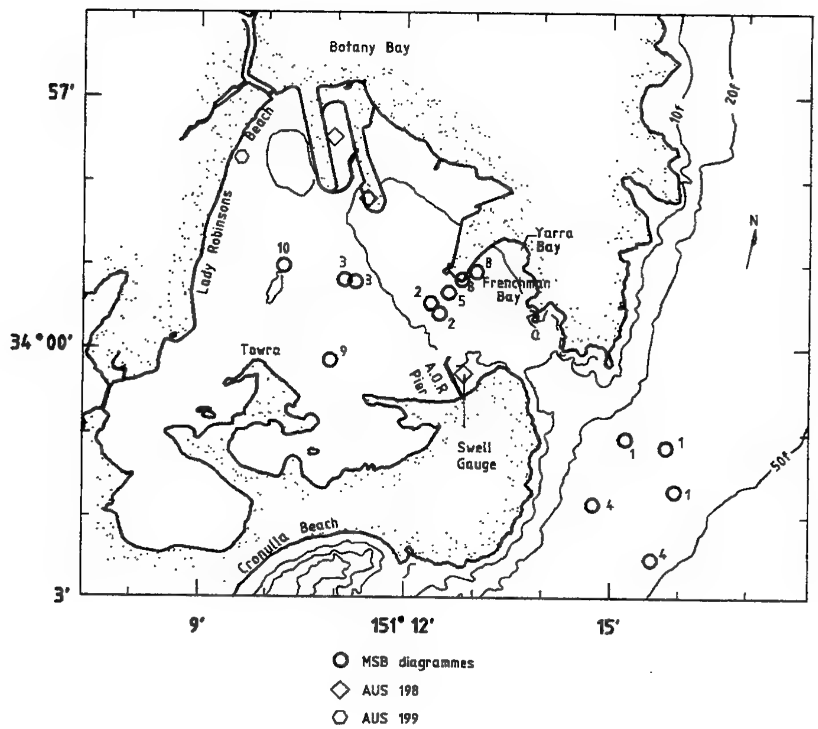

Fig 5.3.2c. New South Wales Botany Bay waverider buoy location history (various sources). Compare with Fig 5.3.2b. AUS198 and AUS199 are Hydrographic Office chart numbers. The swell gauge at the A.O.R. pier is simply a pole against which visual estimations of swell height are made.

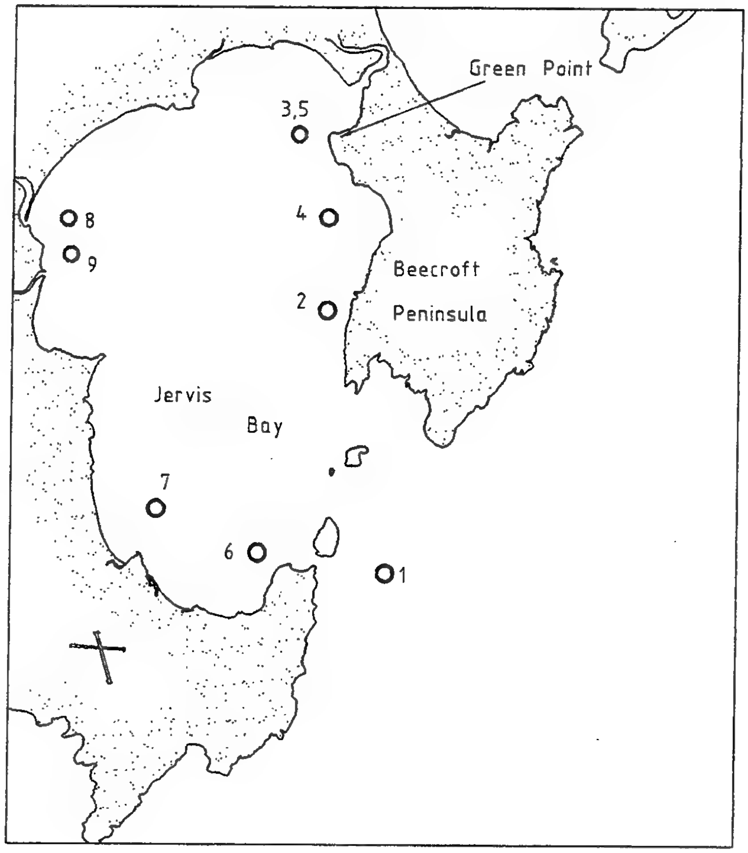

Fig. 5.3.3. Historical Jervis Bay waverider buoy locations. See Table 5.3.3 for details.

WAVE MEASUREMENTS WITHIN JERVIS BAY

Location	Period	Type of Measurement
1. Offshore	Nov 1982 - Present	Waverider - H_s, T only
2. Off Bindijine Cove	Nov 1982 - Feb 1986	Waverider - H_s, T only
3. Off Green Point	Nov 1982 - Feb 1988	Waverider - H_s, T only
4. Off Long Beach	Feb 1988 - Present Mar 1983 - Mar 1984 Jun 1984 - Sep 1984	Waverider - H_s, T only Seadata 635-H-11C Long Period Waves
5. Off Green Point	Aug 1985 - Sep 1985 Jun 1984 - Sep 1984	Seadata 635-12 Directional wave, tide, current, water temp Seadata 635-11C Long Period Waves
6. Darling Road	Feb 1986 - Feb 1988	Waverider - H_s, T only
7. Off Hyams Beach	Feb 1988 - Present	Waverider - H_s, T only
8. Off Currumbene Creek	Nov 1981 - Jul 1988 Jul 1987 - Jun 1988	Swartz Pole - H_s, T Swartz Pole - water level
9. Off Huskisson	Sep 1981 - Oct 1983	Swartz Pole - H_s, T and water level (part time only)

Table 5.3.3. Some details of the wave measurement sites in Jervis Bay shown in Fig 5.3.3 (Sinclair Knight & Partners 1989).

BEACH NAME	START DATE	FINISH DATE
Arrawarra Beach	02-08-84	12-04-85
Avalon Beach	30-10-79	31-10-87
Avoca Beach	21-12-80	30-11-82
Bilgola Beach	30-10-79	08-02-82
Bondi Beach	01-11-79	06-05-85
Bronte Beach	01-11-79	09-11-82
Coogee Beach	01-11-79	03-12-86
Collaroy Beach	31-10-79	22-03-83
Corindi Beach	22-10-80	17-11-87
Culburra Beach	12-01-83	31-10-87
Dee Why Beach	30-10-79	29-04-82
Diamond Beach	02-01-81	04-08-86
Dunbogan Beach	19-02-81	20-10-87
Elouera Beach	02-11-79	01-08-80
Flynns Beach	21-02-81	13-09-81
Freshwater Beach	30-10-79	27-06-80
Jimmys Beach	11-04-83	31-07-85
Lighthouse Beach	10-04-81	17-06-81
Long Reef Beach	30-10-79	28-03-80
Manly Beach	13-11-79	12-02-81
Maroubra Beach	01-11-79	10-12-86
Mona Vale Beach	30-10-79	30-04-80
Narooma Beach	08-02-83	24-07-86
New Brighton Beach	28-05-81	29-05-86
Newport Beach	30-10-79	31-10-87
North Boambee Beach	07-08-80	24-08-85
North Cronulla Beach	02-11-79	07-04-81
North Sapphire Beach	07-08-80	05-08-85
North Steyne Beach	11-11-79	31-03-80
Palm Beach	30-10-79	28-10-80
Park Beach	08-08-80	24-02-86
Queenscliff Beach	10-11-79	14-01-81
Red Rock Beach	28-11-80	08-12-87
Sandys Beach	14-08-80	17-11-87
Sawtell Beach	07-08-80	06-07-83
Scotts Head	22-11-80	31-10-87
South Beach	04-01-83	28-03-83
South Cronulla Beach	01-11-79	06-02-81
South Curl Curl Beach	29-04-80	30-11-81
Tamarama Beach	01-11-79	21-04-81
Town Beach	12-02-81	16-04-81
Wanda Beach	02-11-79	27-04-81
Warilla Beach	27-10-82	05-12-82
Warriewood Beach	02-05-80	11-01-82
Whale Beach	30-10-79	4-11-87
Woolgoolga Beach	30-10-80	29-04-84

Table 5.3.5. List of Surf Environment Analysis (SEA) study programme sites (conducted by PWD with Lawson & Treloar Pty Ltd). See Fig 5.3.5a-d for locations.

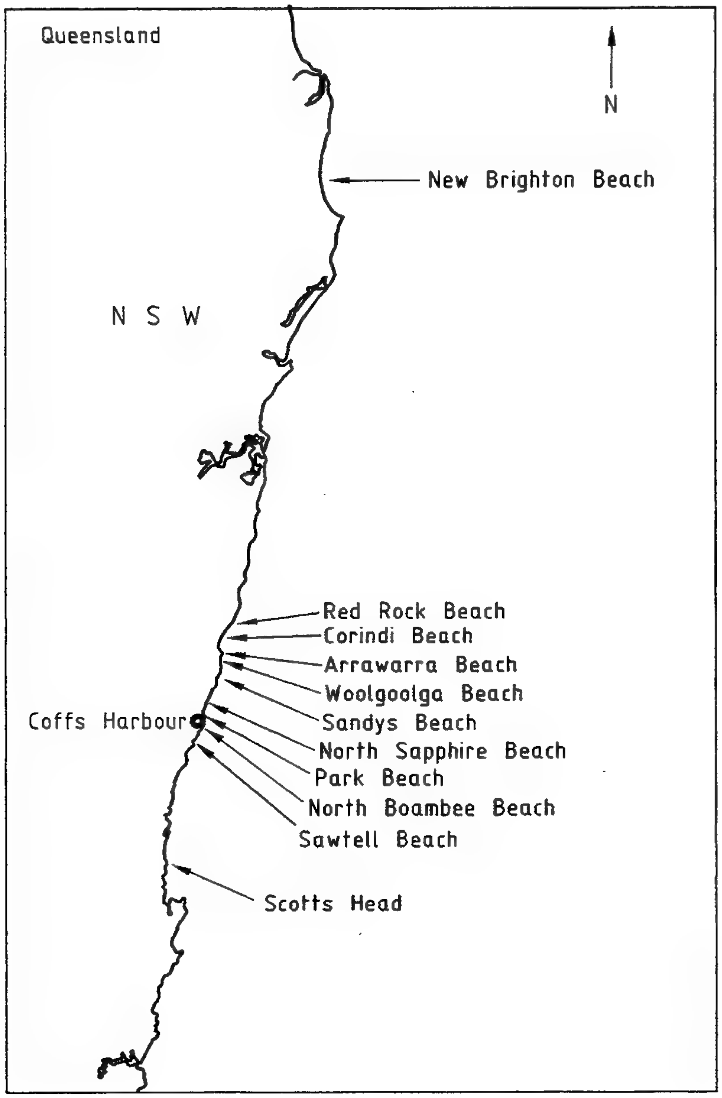

Fig. 5.3.5a. Locations for selected Surf Environment Analysis study programme sites. Coffs Harbour area. (PWD - Lawson & Treloar)

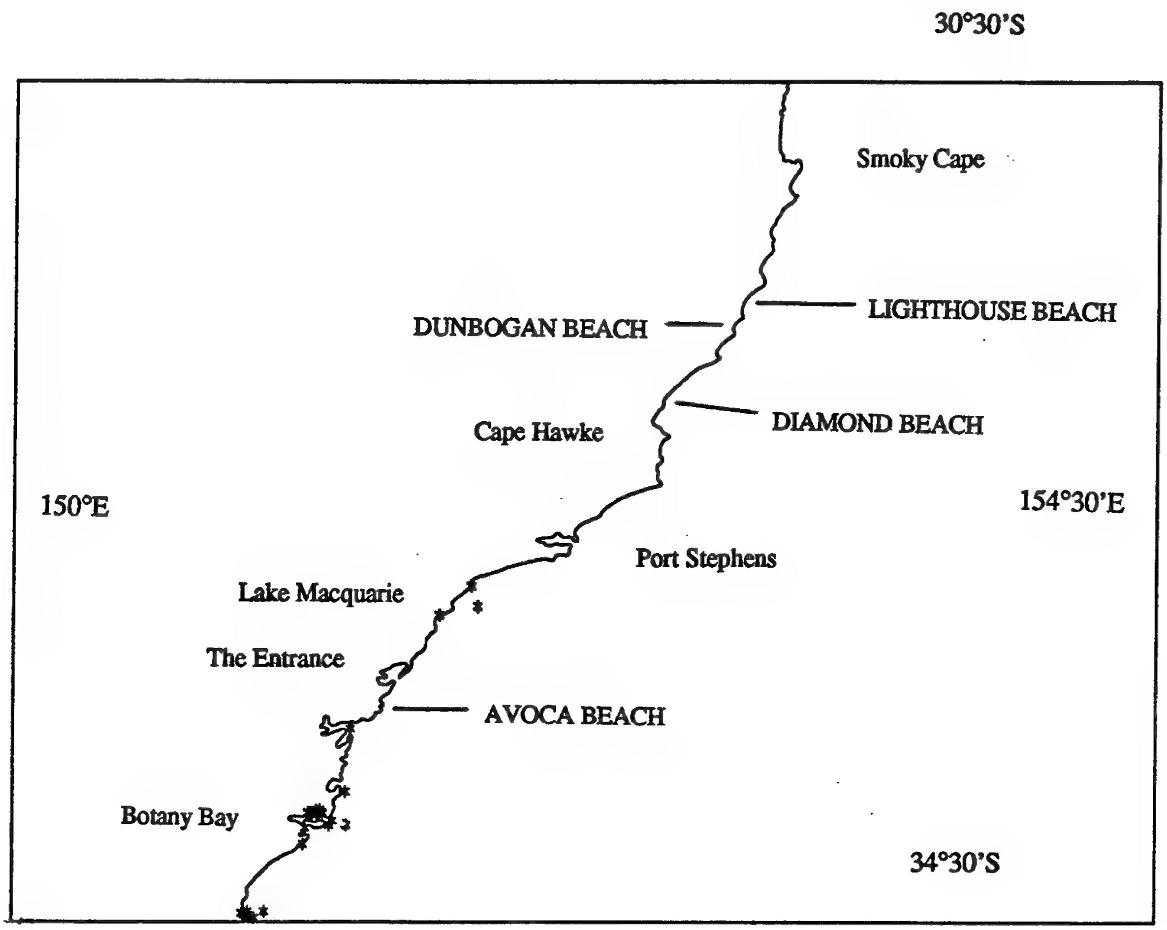

Fig. 5.3.5b. Locations for selected Surf Environment Analysis study programme sites. North coast area. (PWD - Lawson & Treloar)

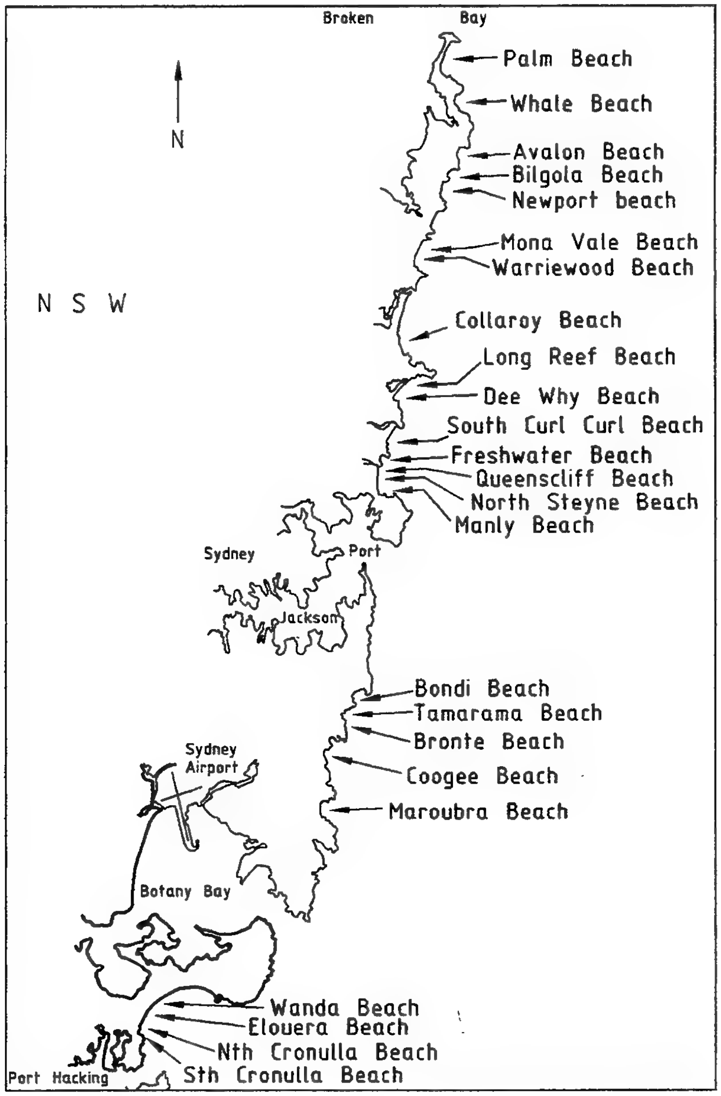

Fig. 5.3.5c. Locations for selected Surf Environment Analysis study programme sites. Sydney area. (PWD - Lawson & Treloar)

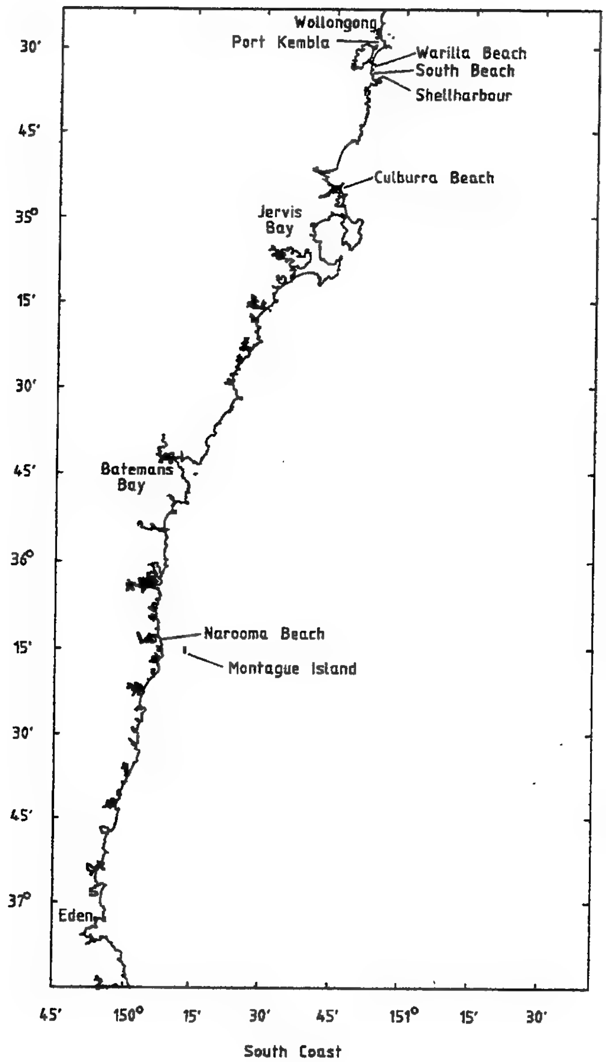

Fig. 5.3.5d. Locations for selected Surf Environment Analysis study programme sites. South coast. (PWD - Lawson & Treloar)

LIST OF SELECTED ARCHIVED WAVE DATA SITES - New South Wales

Note that a listing in this document for data or reports does not necessarily mean that the data or reports are available for public use or perusal, or that data or reports are free of charge. Requests for data or information should not be made to DSTO, but directly to the organisations which gathered the data.

1. Symbols used:
* = entries from the MIAS Catalogue Of Wave Data 1982.
^ = update to MIAS obtained in 1995
A.O.R. = Australian Oil Refinery (Botany Bay)
B = Beach Protection Authority Queensland
DWR = Directional data
E = Environmental Protection Agency
L = Lawson & Treloar
LMcCT = Lawson, McCowan and Treloar (1987)
MAP = Position shown on map - exact co-ordinates unknown
N&L = Nelson and Lawson (1985)
pr = pressure
S = Sydney Ports Corporation (SPC)
S4 = InterOcean S4 current meter
V = Victorian Institute of Marine Sciences

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NEW SOUTH WALES (by latitude) (ALSO SEE MHL Report No. 627)
SEE APPENDIX I FOR AN ALPHABETICAL LISTING OF ALL SITES KNOWN TO HAVE WAVE DETAILS

B                          ; Tweed Heads; 13/01/95-99/99/99
* 30 18 35 S 153 09 42 E; Coffs Harbour; 26/01/75-06/01/76
* 30 20 38 S 153 14 07 E; Coffs Harbour; 26/05/76-?
* 32 54 53 S 151 48 32 E; Nobby's Head, Newcastle; 31/01/75-?
S 32 54 56 S 151 48 26 E; Newcastle (Breakwater #6); 19/05/83-99/99/99; SPC
S 32 54 57 S 151 48 37 E; Newcastle (Breakwater #2); 12/02/75-99/99/99; SPC
* 33 00 35 S 151 50 05 E; Nobby's Head, Newcastle; 31/01/75-12/05/82; SPC
L                          ; Newcastle; 29/12/80-03/11/82; 70m; LMcCT (1987)
L                          ; Newcastle; 29/12/80-04/01/84; 20m; LMcCT (1987)
L                          ; Newcastle; 29/12/80-23/05/83; 20m; LMcCT (1987)
L 33 03    S 151 41    E; Belmont; 00/12/89-00/04/90; 19 m
L 33 03    S 151 41    E; Belmont; 00/07/90-00/12/90; 19 m
* 33 35 00 S 151 20 00 E; Broken Bay; 15/07/77-?
* 33 35 00 S 151 20 00 E; Broken Bay; 18/08/77-31/12/79
E 33.75    S 151.3667  E; Long Reef; 00/07/89-00/09/93; EPA
^ 33 58 10 S 151 13 03 E; Botany Bay (Re-entrant port (15)); 20/12/79-05/03/81
^ 33 58 15 S 151 12 15 E; Botany Bay (Small Boat Harbour); 20/03/81-21/05/82
* 33 58 44 S 151 13 14 E; Botany Bay, Revetment 115; 01/04/71-?
S 33 58 44 S 151 13 14 E; Botany Bay, Revetment (12); 25/08/77-27/02/78
* 33 58 53 S 151 12 58 E; Botany Bay, Revetment 117; 01/04/71-?
S 33 58 53 S 151 12 58 E; Botany Bay, Revetment (13); 25/08/77-27/02/78
* 33 58 55 S 151 13 35 E; Botany Bay, Yarra; 01/04/71-?
S 33 58 55 S 151 13 35 E; Botany Bay, Yarra (11); 30/11/76-27/02/78
* 33 58 59 S 151 10 11 E; Botany Bay, Brighton (10); 18/02/71-22/10/75; SPC
S 33 58 59 S 151 10 11 E; Botany Bay, Brighton (10); 06/08/92-14/09/94; DWR
S 33 58 59 S 151 10 11 E; Botany Bay, Brighton (10); 14/09/94-99/99/99; DWR
* 33 59 08 S 151 11 10 E; Botany Bay, Runway (3); 18/02/71-23/03/75; SPC
* 33 59 09 S 151 12 51 E; Botany Bay, Revetment; 01/04/71-?
S 33 59 09 S 151 12 51 E; Botany Bay, Revetment (8); 31/01/73-24/05/78
* 33 59 11 S 151 13 38 E; Botany Bay, Frenchman's Bay (7); 01/04/71-?
* 33 59 17 S 151 12 39 E; Botany Bay  Entrance Channel; 01/04/71-?
S 33 59 17 S 151 12 39 E; Botany Bay  Entrance Channel (6); 28/08/75-05/10/76
^ 33 59 20 S 151 12 30 E; Botany Bay  Entrance Channel; 19/11/80-99/99/99
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* 33 59 31 S 151 12 22 E; Botany Bay, A.O.R.; 01/04/71-03/08/76; SPC
* 34 00 10 S 151 10 32 E; Botany bay, Towra; 01/04/71-?
S 34 00 10 S 151 10 32 E; Botany bay, Towra; 22/10/75-14/04/89
* 34 01 23 S 151 15 55 E; Botany Bay offshore; 01/04/71-09/08/77; 73 m; SPC
S 34 02 34 S 151 15 08 E; Botany Bay offshore; 05/05/77-?; 73 m; MSB
* 34 02 35 S 151 19 09 E; Botany Bay (site 4); 01/04/71-?
S 34 02 35 S 151 19 09 E; Botany Bay (site 4); 05/05/77-10/06/77
S 34 02 34 S 151 15 08 E; Botany Bay (site 4); 10/06/77-99/99/99
L                        ; Botany Bay; 17/06/80-23/06/84; 60 m; LMcCT (1987)
-                        ; Botany Bay offshore; 26/07/83-?
-                        ; Bondi; 13/07/83-15/08/83; pr; 60 m; 6248900N, 343395E
- 33 53    S 151 18 54 E; Bondi; 00/08/90-?; heave sensors, Ocean Reference Stn
-                        ; Malabar; 13/07/83-15/08/83; pr; 80 m; 6239181N, 342655E
* 34 03 22 S 151 09 31 E; Cronulla; 17/02/77-06/06/79
L 34 08    S 151 09    E; Providential Head; 00/11/90-00/01/91; 35 m; DWR
* 34 27 04 S 150 59 47 E; Port Kembla; 25/10/76-?
^ 34 27 03 S 150 55 51 E; Port Kembla (offshore), #1; 05/05/82-01/05/94
* 34 27 32 S 150 54 30 E; Port Kembla; 07/02/74-?
^ 34 27 51 S 150 55 05 E; Port Kembla (inshore), #2; 05/05/82-01/05/94; SPC
S 34 27 54 S 150 54 54 E; Port Kembla (inshore), #1; 19/05/94-99/99/99
* 34 27 59 S 150 56 04 E; Port Kembla; 07/02/74-01/08/74
* 34 28 52 S 150 57 22 E; Port Kembla; 07/02/74-18/12/76
L 34 28    S 150 55    E; Port Kembla; 10 m; 00/09/92-00/01/93;; 3 pressure sites
L 35 07.32 S 150 47.40 E; Jervis Bay; 05/11/82-00/02/90; Site 1; 50m; LMcCT
- 35 03.42 S 150 46.28 E; Jervis Bay; 05/11/82-25/02/86; Site 2; 12m; N&L
L 35 01 10 S 150 45 42 E; Jervis Bay, Green Pt;05/11/82-00/02/88; Site 3; 12m; N&L
L 35 02 35 S 150 46 22 E; Jervis Bay; 15/03/83-08/03/84; Site 4; 12m; N&L; Seadata
L 35 02 35 S 150 46 22 E; Jervis Bay; 01/06/84-03/09/84; Site 4; 12m; N&L; Seadata
L 35 02 35 S 150 46 22 E; Jervis Bay; 00/07/87-00/10/87; Site 4; 12m; N&L; Seadata
L 35 02 35 S 150 46 22 E; Montagu Roadstead, Jervis Bay; 00/02/88-00/02/90; 13 m
- 35 03.42 S 150 46.28 E; Jervis Bay; 05/11/82-00/02/86; Site 2; 12m; N&L
- 35 01.10 S 150 45.42 E; Jervis Bay; 05/11/82-00/02/88; Site 3; 12m; N&L
-                        ; Jervis Bay; 00/06/84-00/09/84; Site 5; Long period
-                        ; Jervis Bay; 00/08/85-00/09/85; Site 5; DWR
L 35 07.4  S 150 44.4  E; Darling Road; 27/02/86-00/02/88; Site 6; 18 m;
-                        ; Jervis Bay; 00/02/88-?       ; Site 7;
L 35 07    S 150 42    E; Jervis Bay, Hyams Beach; 00/02/88-00/02/90;
-                        ; Jervis Bay; 00/11/81-00/07/88; Site 8; Zwarts pole (PWD)
-                        ; Jervis Bay; 00/07/87-00/06/88; Site 8; Zwarts pole (PWD)
-                        ; Jervis Bay; 00/09/81-00/10/83; Site 9; Zwarts pole (PWD)
* 37 06 22 S 150 00 10 E; Eden Pilot Light Twofold Bay; 08/02/78-?
* 37 04 35 S 149 54 28 E; Eden Breakwater, Twofold Bay; 08/02/78-?


VIMS surf zone measurements
V                        ; Eden; 19/02/88-25/02/88
V                        ; Pambula; 27/02/92-28/02/92
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The following tables were provided by Mark Kulmar of the Manly Hydraulics Laboratory, Public Works Department of New South Wales.

Table MHL1. NSW Wave Data - Offshore Stations: June 1995

Wave Data Site	Instrument	AMG Location* Easting	AMG Location* Northing	Water Depth (m)	Data Available 1st Date	Data Available Last Date	Record Length (years)	Data Capture (%)
Byron Bay	Waverider buoy	571560	6827760	72	14-Oct-76	Present	18.71	69.9
Coffs Harbour	Waverider buoy	525600	6642550	73	26-May-76	Present	19.09	82.7
Crowdy Head	Waverider buoy	487050	6478900	79	10-Oct-85	Present	9.72	87.0
Sydney	Waverider buoy	353280	6262140	85	17-Jul-87	Present	7.95	95.2
Sydney Directional	Directional Waverider	353840	6262230	87	03-Mar-92	Present	3.32	74.8
Port Kembla	Waverider buoy	318650	6183150	78	07-Feb-74	Present	21.39	81.4
Batemans Bay	Waverider buoy	259750	6044450	73	27-May-86	Present	9.09	92.6
Eden	Waverider buoy	250000	5869580	110	08-Feb-78	Present	17.39	76.3

* Australian Map Grid coordinates relative to false origin of Zone 56.

Table MHL 2. NSW Wave Data - Site Specific Stations : June 1995

Wave Data Site	Instrument	AMG Location* Easting	AMG Location* Northing	Water Depth (m)	Data Available 1st Date	Data Available Last Date	Record Length (years)	Data Capture (%)
Tweed River	Zwarts Pole	553860	6883725	4	20-Jan-95	Present	0.44	98.0
Tweed Heads Inshore	Waverider buoy	555294	6883017	13	21-Apr-89	08-Nov-89	0.55	98.1
Tweed Heads	Marsh McBirney	555294	6883017	13	09-Jun-88	10-Oct-89	1.34	58.1
Cook Island	Marsh McBirney / S4	556003	6881182	12	09-Jun-88	25-Oct-89	1.38	39.6
Fingal Head	Marsh McBirney / S4	556079	6879564	12	09-Jun-88	25-Oct-89	1.38	28.8
Coffs Harbour Entrance	Marsh McBirney	514665	6646863	9	04-Dec-86	31-Oct-87	0.91	53.2
Coffs Harbour Roving	Marsh McBirney	Various	Locations	-	04-Dec-86	25-Nov-87	0.98	80.4
Coffs Harbour Jetty	Zwarts pole	513840	6647148	7	05-Nov-86	Present	8.65	83.1
Crowdy Head Harbour	Zwarts pole	476318	6477138	2	07-Nov-86	Present	8.64	90.9
Jimmys Beach	Zwarts pole	421665	6383610	3	16-Dec-83	08-Oct-85	1.81	85.6
Nelson Bay	Zwarts pole	419470	6379465	6	20-Jan-81	20-Apr-88	7.25	45.5
Swansea	Zwarts pole	375079	6338043	2	17-Dec-87	12-Apr-91	3.32	98.6
Broken Bay	Waverider buoy	346190	6285235	24	30-Jan-81	02-Jun-83	2.34	51.7
Palm Beach	Marsh McBirney	345650	6281755	24	19-Jun-81	14-Sep-82	1.24	41.1
Broken Bay Current	Marsh McBirney	346190	6284795	24	23-Nov-79	15-Feb-83	3.23	71.7
Mackerel Beach	Zwarts pole	342270	6281775	2	17-Aug-88	15-Oct-89	1.16	97.0
Melrose Park (Parramatta R)	Zwarts pole	321365	6255975	2	24-Mar-88	20-Jul-88	0.32	82.3
Chiswick (Parramatta River)	Zwarts pole	327650	6253076	2	28-Mar-88	20-Jul-88	0.31	72.9
Port Hacking Seaward	Zwarts pole	328830	6227575	3	06-Sep-83	Present	11.81	72.1
Deeban Spit	Zwarts pole	327850	6227474	2	15-Sep-83	03-Oct-86	3.05	51.6

Table MHL2 (Cont.) Site Specific Stations : June 1995

Wave Data Site	Instrument	AMG Location* Easting	AMG Location* Northing	Water Depth (m)	Data Available 1st Date	Data Available Last Date	Record Length (years)	Data Capture (%)
Port Hacking Seaward MMcB	Marsh McBirney	328830	6227575	3	06-Sep-83	17-Nov-86	3.20	56.6
Deeban Spit MMcB	Marsh McBirney	327850	6227474	2	06-Sep-83	28-May-85	1.73	60.6
Burraneer Point MMcB	Marsh McBirney	327763	6227931	6	06-Sep-83	16-Dec-85	2.28	54.6
Port Kembla Inshore	Waverider buoy	307990	6184970	18	31-May-78	26-Jul-82	4.15	72.8
Jervis Bay North	Zwarts pole	287850	6120050	6	11-Nov-81	03-Jul-89	7.64	62.5
Jervis Bay South	Zwarts pole	228500	6118800	8	01-Sep-81	18-Oct-83	2.13	34.7
Batemans Bay Inshore	Zwarts pole	247792	6043097	7	26-Feb-87	08-Dec-90	3.78	94.1
Eden Inshore	Waverider buoy	758230	5892820	9	24-Nov-84	11-May-87	2.46	75.2
Eden Harbour	Zwarts pole	758324	5892999	4	24-Nov-84	Present	10.60	77.1

* Australian Map Grid coordinates relative to false origin of Zone 56.

Table MHL3 Long Wave Stations : analysed wave data - June 1995 (from New South Wales Wave Climate Annual Summary 1994/95) (Report MHL733)

Water level data collected at selected Zwarts Pole locations are filtered and analysed to provide long wave statistics. Long waves have periods which range from 30 seconds to several minutes, and are often associated with storm wave activity off the NSW coast.

Analysed Wave Data at Manly Hydraulics Laboratory : Long Wave Stations - June 1995

Wave Data Site	Instrument	AMG Location Easting	AMG Location Northing	Water Depth (m)	Data Available First Date	Data Available Last Date	Record Length (years)	Data Capture (%)
Tweed River	Zwarts Pole	553860	6883725	4	20-Jan-95	Present	0.44	97.4
Coffs Harbour Jetty	Zwarts pole	513840	6647148	7	13-Jul-87	Present	7.96	86.4
Crowdy Head Harbour	Zwarts pole	476318	6477138	2	24-Jul-87	Present	7.93	90.4
Swansea	Zwarts pole	375079	6338043	2	09-Sep-88	12-Apr-91	2.59	98.1
Mackerel Beach	Zwarts pole	342270	6281775	2	17-Aug-88	15-Oct-89	1.16	96.4
Port Hacking	Zwarts pole	328830	6227575	3	20-Nov-87	Present	7.61	85.4
Jervis Bay North	Zwarts pole	287850	6120050	6	30-Jul-87	03-Jul-89	1.93	87.8
Batemans Bay	Zwarts pole	247792	6043097	7	26-Aug-87	08-Dec-90	3.29	95.3
Eden Harbour	Zwarts pole	758324	5892999	4	28-Jul-87	Present	7.92	90.7

NOTE: Australian Map Grid (AMG) coordinates relative to false origin of Zone 56.

Table MHL4 Raw Wave Data on optical disc at MHL - June 1995 (from New South Wales Wave Climate Annual Summary 1994/95) (Report MHL733)

Raw Wave Data at Manly Hydraulics Laboratory : Time Series Data Stored on Optical Disk - June 1995

Wave Data Site	Instrument	Site Category	Available Analysed Data		Available Raw Data	
			First Data	Last Date	First Date	Last Date
Tweed River	Zwarts pole	Inshore	20-Jan-95	Present	20-Jan-95	Present
Tweed Heads Inshore	Waverider buoy	Inshore	21-Apr-89	08-Nov-89	21-Apr-89	08-Nov-89
Byron Bay	Waverider buoy	Offshore	14-Oct-76	Present	12-Aug-83	Present
Coffs Harbour	Waverider buoy	Offshore	26-May-76	Present	29-Jul-83	Present
Coffs Harbour Jetty	Zwarts pole	Inshore	05-Nov-86	Present	05-Nov-86	Present
Crowdy Head	Waverider buoy	Offshore	10-Oct-85	Present	10-Oct-85	Present
Crowdy Head Harbour	Zwarts pole	Inshore	07-Nov-86	Present	07-Nov-86	Present
Jimmys Beach	Zwarts pole	Inshore	16-Dec-83	08-Dec-85	16-Dec-83	09-Sep-85
Nelson Bay	Zwarts pole	Inshore	20-Jan-81	20-Apr-88	20-Jan-81	20-Apr-88
Swansea	Zwarts pole	Inshore	17-Dec-87	12-Apr-91	17-Dec-87	12-Apr-91
Mackerel Beach	Zwarts pole	Inshore	17-Aug-88	15-Oct-89	17-Aug-88	15-Oct-89
Sydney	Waverider buoy	Offshore	17-Jul-87	Present	17-Jul-87	Present
Melrose Park (Parramatta R)	Zwarts pole	River	24-Mar-88	20-Jul-88	24-Mar-88	20-Jul-88
Chiswick (Parramatta River)	Zwarts pole	River	28-Mar-88	20-Jul-88	28-Mar-88	20-Jul-88
Port Hacking Seaward	Zwarts Pole	Inshore	06-Sep-83	Present	06-Sep-83	Present
Deeban Spit	Zwarts pole	Inshore	15-Sep-83	03-Oct-86	15-Sep-83	03-Oct-86
Port Hacking Seaward MMcB	Marsh McBirney	Inshore	06-Sep-83	17-Nov-86	06-Sep-83	16-Nov-86
Deeban Spit MMcB	Marsh McBirney	Inshore	06-Sep-83	28-May-85	06-Sep-83	26-May-85
Burraneer Point MMcB	Marsh McBirney	Inshore	06-Sep-83	16-Dec-85	06-Sep-83	03-Sep-85
Port Kembla	Waverider buoy	Offshore	07-Feb-74	Present	31-Jul-83	Present
Jervis Bay North	Zwarts pole	Inshore	11-Nov-81	03-Jul-89	27-Dec-82	03-Jul-89
Jervis Bay South	Zwarts pole	Inshore	01-Sep-81	18-Oct-83	04-Jan-83	17-Oct-83
Batemans Bay	Waverider buoy	Offshore	27-May-86	Present	27-May-86	Present
Batemans Bay Inshore	Zwarts pole	Inshore	26-Feb-87	08-Dec-90	26-Feb-87	08-Dec-90
Eden	Waverider buoy	Offshore	08-Feb-78	Present	26-Jul-83	Present
Eden Inshore	Waverider buoy	Inshore	24-Nov-84	11-May-87	24-Nov-84	11-May-87
Eden Harbour	Zwarts pole	Inshore	24-Nov-84	Present	24-Nov-84	Present

5.4 Victoria (including Bass Strait)

Data from the Barracouta and Kingfish B oil platforms in Bass Strait (Fig 5.4) are believed to be held by **Esso Australia Limited** and **Broken Hill Proprietary companies**, and by contractors, specifically **Lawson and Treloar**. "Routine measurements of waves commenced at Kingfish B and Barracouta platforms by Esso Australia Ltd in 1977. The wave measurements from Kingfish B are continuing, while those from Barracouta ceased in the middle of 1987. These measurements, combined with the study of Esso Australia Ltd (1990), adequately describe the offshore wave climate in eastern Bass Strait" (Black et al 1994). Silbert et al (1980) state that Kingfish B and Barracouta were instrumented with a wave staff.

5.4.1 Port Phillip Bay

A list of historical wave data for the bay is available from the **Port Of Melbourne Authority** (Fig 5.4.1), and was supplied to CSIRO for the Port Phillip Bay environmental study. A list was made available by the Authority to DSTO for this report.

LIST OF SELECTED ARCHIVED WAVE DATA SITES - Victoria including Bass Strait

Note that a listing in this document for data or reports does not necessarily mean that the data or reports are available for public use or perusal, or that data or reports are free of charge. Requests for data or information should not be made to DSTO, but directly to the organisations which gathered the data.

1. Symbols used:
* = entries from the MIAS Catalogue Of Wave Data 1982.
^ = update to MIAS obtained in 1995
DWR = Directional data
L = Lawson & Treloar
m = Monash University
MAP = Position shown on map - exact co-ordinates unknown
T = Port Of Melbourne Authority
V = Victorian Institute of Marine Science
Z = WNI Science & Engineering

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BASS STRAIT (by longitude)
SEE APPENDIX I FOR AN ALPHABETICAL LISTING OF ALL SITES KNOWN TO HAVE WAVE DETAILS

m 40 28      S 144 20     E; Black Pyramid; 00/11/81-00/12/81; 55 m; pressure 4Hz
m 40 28      S 144 20     E; Black Pyramid; 00/07/82-00/07/82; 55 m; pressure 4Hz
m 40 28      S 144 20     E; Black Pyramid; 00/03/83-00/03/83; 55 m; pressure 4Hz
L 38 18      S 147 41     E; Barracouta Platform; 00/12/77-00/05/87; 46 m; Wavestaff
L 38 36      S 148 11     E; Kingfish B Platform; 00/12/77-99/99/99; DWR from 1989
Z 38.3153    S 148.6361   E; see Fig 6.1; 28/03/82-21/04/82; information from WNI
Z 38.1341    S 148.8080   E; see Fig 6.1; 08/04/82-22/04/82; information from WNI
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VICTORIA (alphabetically)
SEE APPENDIX I FOR AN ALPHABETICAL LISTING OF ALL SITES KNOWN TO HAVE WAVE DETAILS

T           S           E; Altona; 18/07/74-24/07/75; <5807009N 320751 E>
T MAP       S           E; Aspendale; 03/09/75-09/10/76
* 38 18 54 S 144 24 54 E; Black Rock (Site 1), Barwon Heads; 31/01/79-07/03/80
T 38 18 18 S 144 26 06 E; Black Rock; 22/10/84-27/07/87; <VARIOUS TIMES>
* 38 23 38 S 141 39 55 E; Danger Point, Portland Bay; 20/11/73-22/01/75
* 38 23 25 S 141 40 00 E; Danger Point,Portland Bay; 20/12/73-31/08/76
* 38 23 38 S 141 39 55 E; Danger Point,Portland Bay; 07/12/75-19/05/77
T 38 11.32 S 147 22.33 E; Delray Beach Latrobe outfall; 10/03/91-24/02/92
T           S           E; Dutson Downs; 21/10/87-21/10/87
T 38 29 21 S 145 04 30 E; Flinders; 01/06/92-20/03/94
T           S           E; Frankston; 15/12/76-03/04/77;5777250N 332375E CARRUM 4.4
L 38 27     S 147 08    E; McGaurans Beach; 00/06/91-00/11/91; 35 m; DWR
L 38 27     S 147 08    E; McGaurans Beach; 00/03/93-00/03/93; 35 m; DWR
T           S           E; Metung; 26/02/86-29/07/86
T MAP       S           E; Middle of PPB; 11/07/77-04/07/78
T           S           E; Mornington; 16/03/76-03/04/77;5768794N 324902E CARRUM3.2
T           S           E; Mt Gambier; 01/01/87-13/11/84
T           S           E; Mt. Martha; 23/12/75-05/05/76; 5759298N 322191E BASS 2.8
T           S           E; Phillip Island;
L 38 07     S 144 28    E; Point Wilson; 00/04/93-00/05/93; 5 m
L 38 06     S 144 30    E; Point Wilson; 00/04/94-00/11/94; 5 m
L 38 06     S 144 32    E; Point Wilson; 00/04/94-00/11/94; 9 m
T           S           E; Portland Cape Nelson; 21/02/90-15/03/91
* 38 01     S 145 05    E; Port Phillip, Victoria; 03/09/75-14/12/76
* 38 08 00 S 145 05 48 E; Port Phillip, Victoria; 14/02/76-14/03/77
* 38 09 30 S 144 46 30 E; Port Phillip, Victoria; 29/01/76-01/03/77
* 38 12 48 S 145 00 00 E; Port Phillip, Victoria; 05/05/76-14/12/76
* 38 07 18 S 144 53 42 E; Port Phillip, Victoria; 20/12/76-20/01/78
* 38 17 48 S 144 58 00 E; Port Phillip, Victoria; 30/12/75-01/04/76
* 38 20 00 S 144 55 42 E; Port Phillip, Victoria; 06/11/74-06/12/75
* 37 55 48 S 144 53 12 E; Port Phillip, Victoria; 18/07/74-20/08/75
* 37 52     S 144 56    E; Port Phillip, Victoria; 03/09/75-01/12/75
T 38 16 49 S 144 41 28 E; Queenscliff; 12/05/94-01/02/05; 38 16 48.8S 144 41 27.7E
T           S           E; Rosebud; 06/11/74-21/12/75; 5755155N 319830E BASS2.8 AMG
T           S           E; St. Kilda; 0/09/75-01/12/75; <5806582N 318222E YARRA 2.2
T           S           E; St Leonards; 29/01/76-30/03/77;5774263N 305059E CORIO8.3
* 38 25 48 S 145 14 54 E; Sandy Point, Westernport; 26/02/80-10/04/81
T           S           E; South Channel; 17/07/92-14/09/92
* 38 00 48 S 144 41 42 E; Werribee South, near Port Phillip; 01/08/77-31/12/78
T MAP       S           E; Werribee South; 31/01/79-07/03/80
* 38 05 30 S 144 33 30 E; Wilson Point, near Port Phillip; 01/07/77-31/08/78; POMA
* 38 16 30 S 145 15 58 E; Yaringa, Westernport; 11/03/80-10/04/81
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VIMS surf zone measurements (by longitude)
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See Fig 5.4.2 for locations of these short term surf measurements.

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V                        ; Mallacoota; 21/02/92-26/02/92
V                        ; Point Roadknight; 12/02/92-18/02/92
V                        ; Apollo Bay; 19/02/87-15/04/87
V                        ; Apollo Bay; 17/03/88-23/03/88
V                        ; Apollo Bay; 07/04/89-16/04/89
V                        ; Torquay; 16/03/89-16/03/89
V                        ; Safety Beach; 17/11/89-17/11/89
```

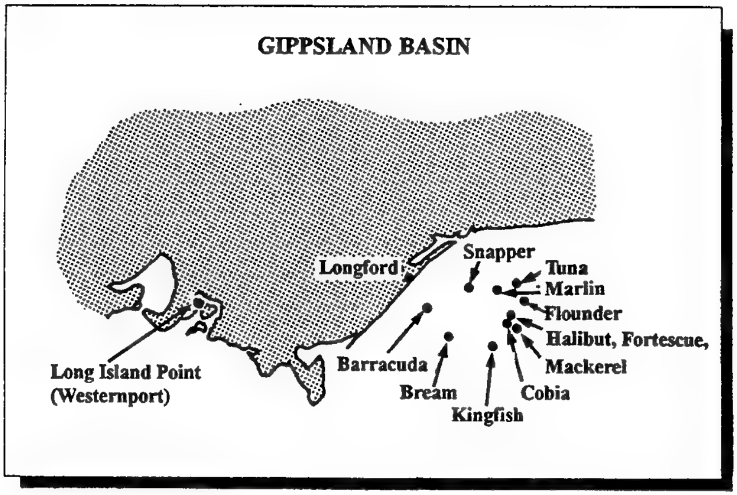


Fig. 5.4. Bass Strait wave-staff locations on Barracouta and Kingfish oil platforms

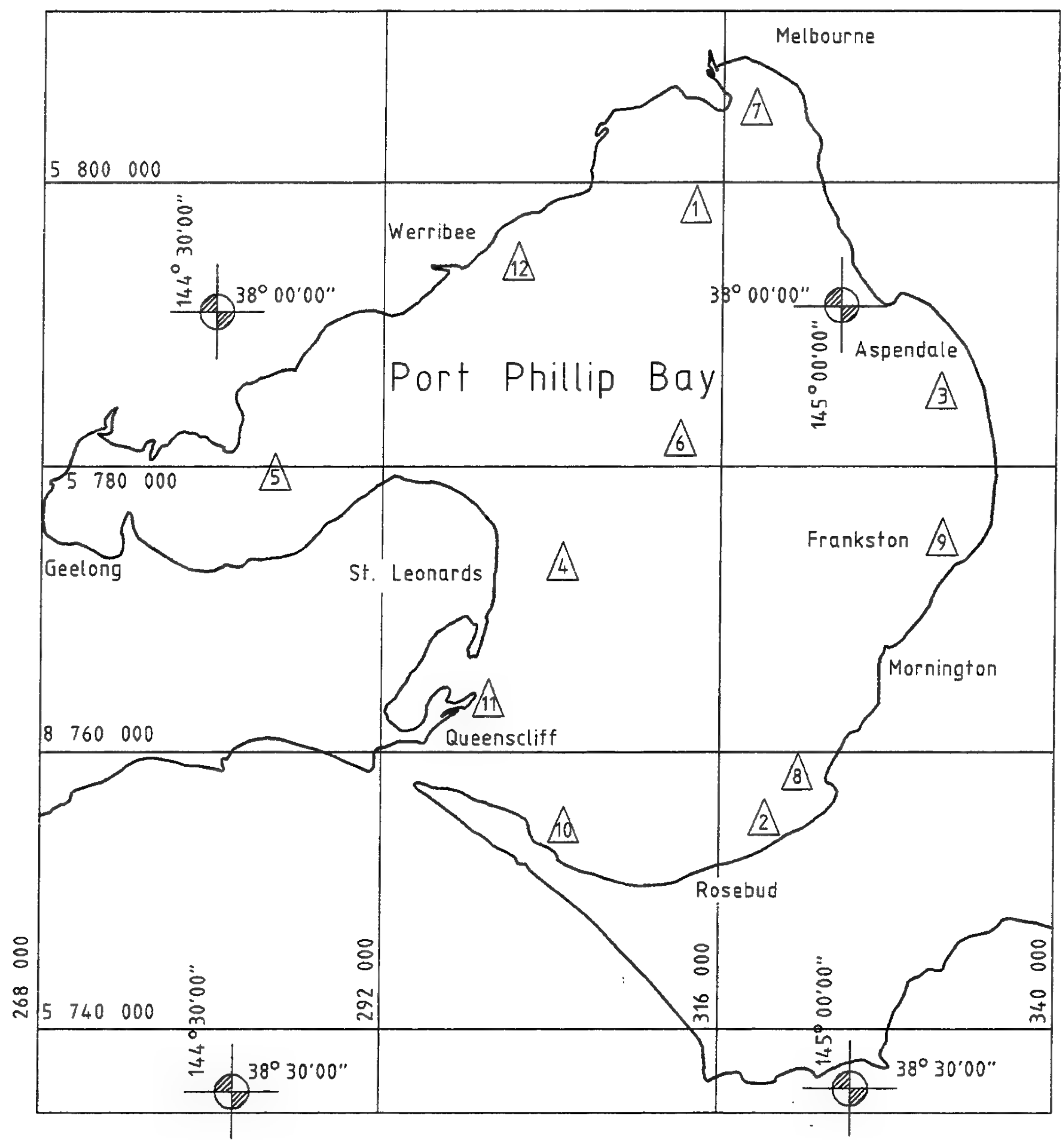


Fig. 5.4.1. Port Phillip Bay historical waverider buoy locations (Port Of Melbourne Authority)

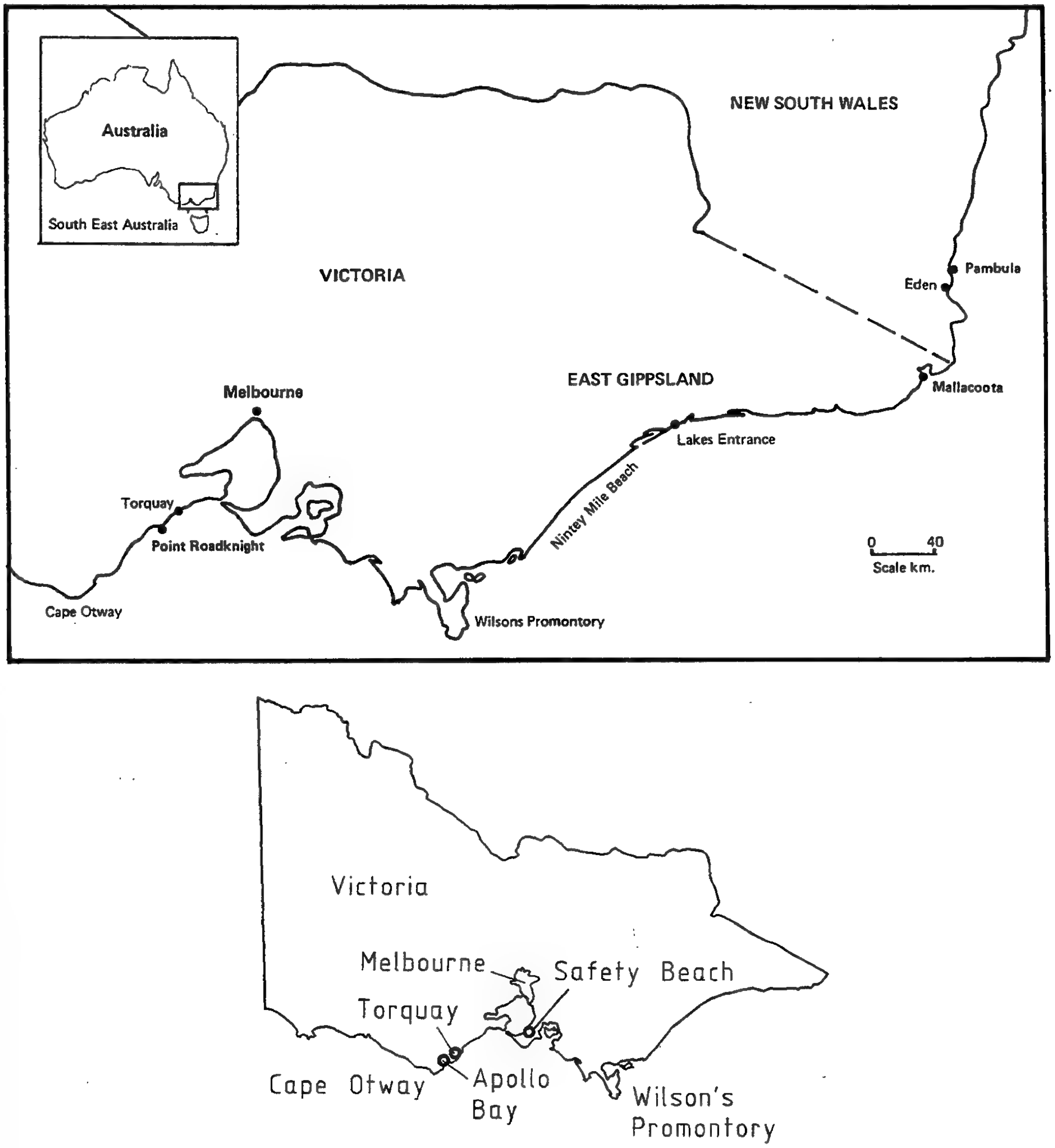


Fig 5.4.2. Locations of short term historical surf measurements made by VIMS.

5.5 Tasmania *(for Bass Strait see Victoria)*

The **CSIRO Marine Laboratories** hold data for Cape Sorell, Cape Grim, and Storm Bay for various periods for 1985 to 1992 (see Fig 5.5 and Table 5.5). See Reid J.S. and Fandry C.B. (1994), "Wave climate measurements in the Southern Ocean", CSIRO Marine Laboratories Report 223. Waverider data were obtained for the Burnie Port Authority in 1983-85, by Lawson and Treloar.

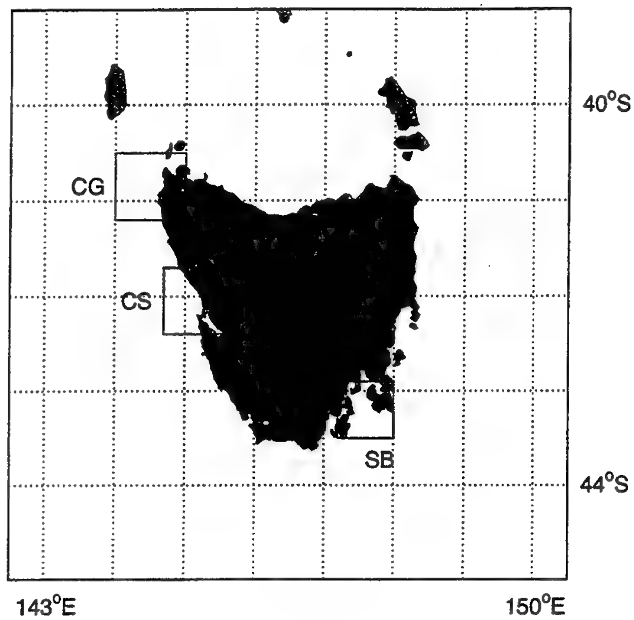
LIST OF SELECTED ARCHIVED WAVE DATA SITES - Tasmania

Note that a listing in this document for data or reports does not necessarily mean that the data or reports are available for public use or perusal, or that data or reports are free of charge. Requests for data or information should not be made to DSTO, but directly to the organisations which gathered the data.

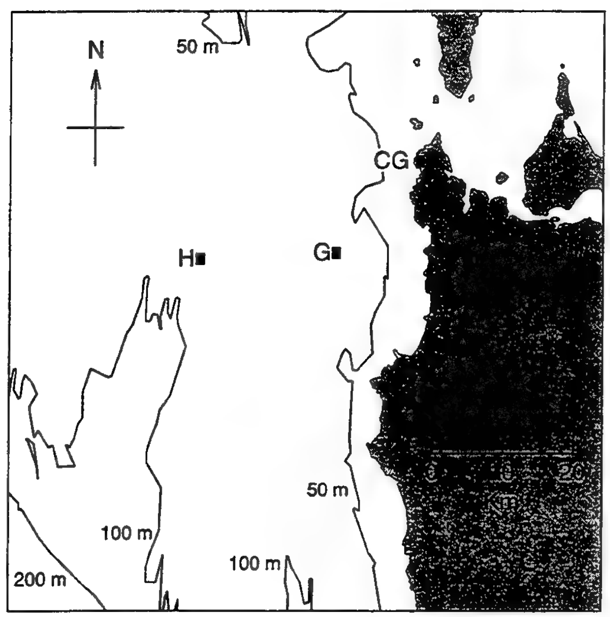
1. Symbols used:
C = CSIRO (Reid and Fandry 1995)
L = Lawson & Treloar

```
TASMANIA (alphabetically)
SEE APPENDIX I FOR AN ALPHABETICAL LISTING OF ALL SITES KNOWN TO HAVE WAVE DETAILS

L 40 58     S 145 53     E; Burnie; 00/11/83-00/09/85; 44 m
C 40 47.0   S 145 33.0   E; Cape Grim; 02/03/92-20/04/92
C 40 47.4   S 145 19.3   E; Cape Grim; 28/03/91-21/04/91
C 40 47.4   S 145 19.3   E; Cape Grim; 12/08/91-20/11/91
C 42 09.0   S 145 01.0   E; Cape Sorell; 11/07/85-18/11/85
C 42 09.0   S 145 01.0   E; Cape Sorell; 18/11/85-02/03/86
C 42 09.0   S 145 01.0   E; Cape Sorell; 04/08/86-09/04/87
C 42 10.0   S 145 09.0   E; Cape Sorell; 11/07/85-18/11/85
C 42 10.0   S 145 09.0   E; Cape Sorell; 18/11/85-07/07/86
C 42 08.7   S 145 09.4   E; Cape Sorell; 27/04/87-21/12/87
C 42 06.1   S 145 03.3   E; Cape Sorell; 22/12/87-11/06/88
C 42 06.1   S 145 03.3   E; Cape Sorell; 01/07/88-25/01/89
C 42 06.1   S 145 03.3   E; Cape Sorell; 15/02/89-29/12/89
C 42 06.1   S 145 03.3   E; Cape Sorell; 26/01/90-29/09/91
C 42 06.1   S 145 03.3   E; Cape Sorell; 12/12/91-24/09/92
C 43 08.6   S 147 39.1   E; Storm Bay; 01/01/93-12/12/93
```

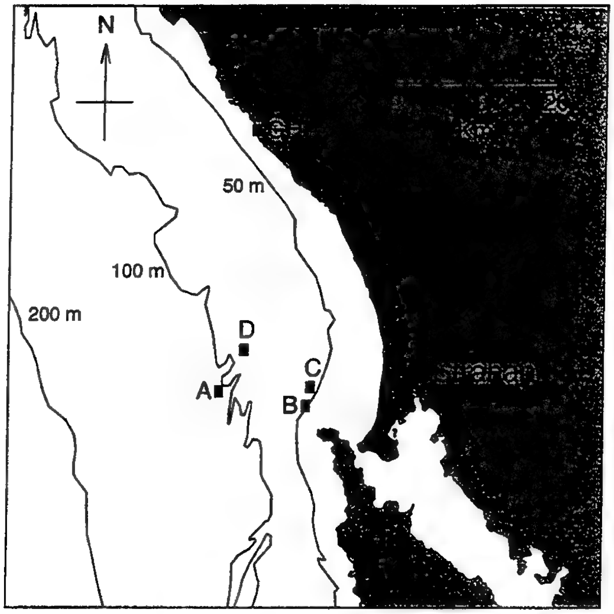


Tasmania showing the three study regions, Cape Grim, "CG", Cape Sorell, "CS" and Storm Bay, "SB".

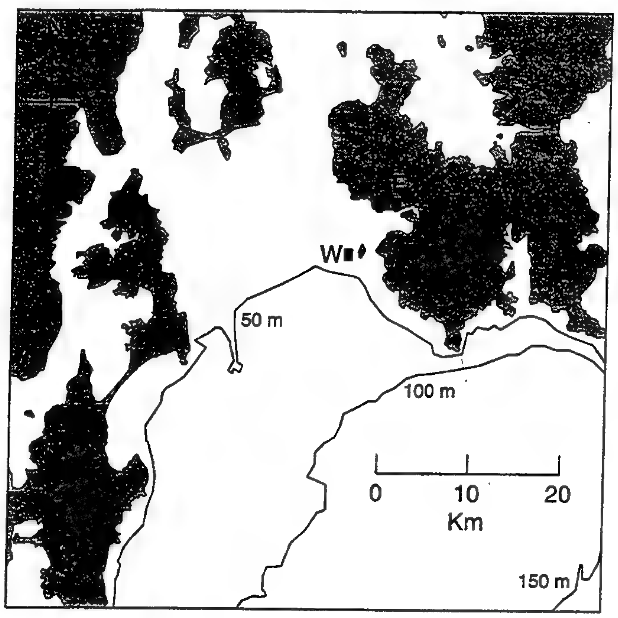


The Cape Grim study region showing the two sites used, "G" and "H". The shore base was locate at the Cape Grim Air Polluution Baseline Monitoring Station, "CG". Depth contours at 50m, 100m and 200m are shown.

Fig. 5.5a. Tasmania. Sites of historical waverider buoy measurements (Reid & Fandry 1994). CG = Cape Grim, CS = Cape Sorell, SB = Storm Bay.



The Cape Sorell study region showing the four buoy sites used, "A","B","C" and "D". Wind data were obtained from Granville Harbour, "GH". The shore base was situated in the township of Strahan. Depth contours at 50m, 100m and 200m are shown.

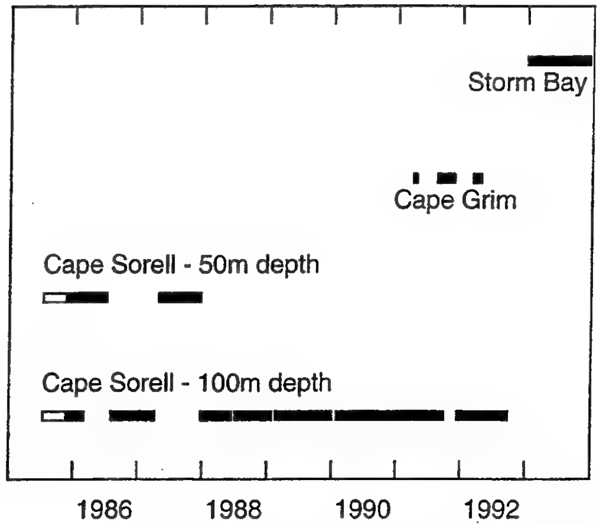


The Storm Bay study region showing the buoy site near Wedge Island, "W", and the shore base at the Nubeena Fish Farm, "F". Depth contours at 50m, 100m and 150m are shown.

Fig. 5.5b. Tasmania. Sites of historical waverider buoy measurements (Reid & Fandry 1994). Cape Sorell and Storm Bay.

label	latitude			longitude			depth
	deg	min		deg	min		metres
A	42	9.0	S	145	1.0	E	100
B	42	10.0	S	145	9.0	E	50
C	42	8.7	S	145	9.4	E	50
D	42	6.1	S	145	3.3	E	100
G	40	47.0	S	145	33.0	E	65
H	40	47.4	S	145	19.3	E	97
W	43	8.6	S	145	39.1	E	40

Waverider buoy sites



Deployment of wave buoys at the four sites. The filled rectangles indicate the intervals and locations at which 800 second long bursts of data were collected every 3 hours. The empty rectangles indicate the intervals and locations at which 400 second bursts were collected every 2 hours.

site	from	to	samples/burst	burst rate
A	11/7/85	18/11/85	1024	2 hourly
A	18/11/85	2/3/86	2048	3 hourly
A	4/8/86	9/4/87	2048	3 hourly
B	11/7/85	18/11/85	1024	2 hourly
B	18/11/85	7/7/86	2048	3 hourly
C	27/4/87	21/12/87	2048	3 hourly
D	22/12/87	11/6/88	2048	3 hourly
D	1/7/88	25/1/89	2048	3 hourly
D	15/2/89	29/12/89	2048	3 hourly
D	26/1/90	29/9/91	2048	3 hourly
D	12/12/91	24/9/92	2048	3 hourly
H	28/3/91	21/4/91	2048	3 hourly
H	12/8/91	20/11/91	2048	3 hourly
G	2/3/92	20/4/92	2048	3 hourly
W	1/1/93	14/12/93	2048	3 hourly

Table 5.5. Details of the waverider deployments of Fig 5.5 .

5.6 South Australia

Data are believed to be held by the **Department of Civil Engineering at the University of Adelaide**. See Culver and Walker (1983). **Shell Exploration** operated a number of waveriders on the South Australian continental shelf (Morgan 1972). "The South Australian Department of Marine and Harbours has been involved in the collection of wave data since 1965" (Culver and Walker 19?). According to MIAS (1982) the **Dept Of Marine and Harbours** holds data for Adelaide, Port Macdonnell, Port Neill, Cape Jervis, Port Giles, and Kangaroo Island. **Flinders Institute for Atmospheric and Marine Sciences** hold data for Cape Jervis (Byrne et al 1974). Fig 5.6 shows general locations.

LIST OF SELECTED ARCHIVED WAVE DATA SITES

Note that a listing in this document for data or reports does not necessarily mean that the data or reports are available for public use or perusal, or that data or reports are free of charge. Requests for data or information should not be made to DSTO, but directly to the organisations which gathered the data.

1. Symbols used:
* = entries from the MIAS Catalogue Of Wave Data 1982.
GAB = Great Australian Bight
L = Lawson & Treloar
Y = Young and Gorman (1995)
Z = WNI Science & Engineering

```
SOUTH AUSTRALIA (by longitude)
SEE APPENDIX I FOR AN ALPHABETICAL LISTING OF ALL SITES KNOWN TO HAVE WAVE DETAILS
* 38 04    S 140 43    E; Port Macdonnell; 00/06/72-00/12/73
* 35 02 00 S 138 30    E; Seacliff; 09/01/81-00/12/82
* 34 47    S 138 29    E; Adelaide, Outer Harbour; 00/05/72-00/11/76
* 34 47    S 138 29    E; Adelaide, Outer Harbour; 10/09/78-30/01/80
L 35 07    S 138 28    E; Port Stanvac; 00/06/88-00/10/88; 12 m; pr
L 35 07    S 138 28    E; Port Stanvac; 00/06/88-00/10/88; 12 m; waverider
L 35 06    S 138 26    E; Port Stanvac; 00/01/92-00/04/92; 22 m
* 35 37    S 138 06    E; Cape Jervis; 00/01/71-00/11/74
* 35 30    S 138 00    E; Cape Jervis; 00/06/74-00/11/74
* 35 43    S 137 57    E; Penneshaw, Kangaroo Island; 00/12/70-00/11/73
* 32 44 00 S 137 50 00 E; Spencer Gulf, Redcliff Point; 27/03/80-24/07/81
* 35 02    S 137 46    E; Port Giles; 00/11/68-00/07/70
-                       ; Wallaroo; Culver & Walker (19--)
-                       ; Tickera; Culver & Walker (19--)
Z 33.8281  S 137.6200  E; Spencer Gulf; 15/01/83-13/04/84;
Z 35.1117  S 136.5633  E; Wedge Island; 22/10/93-22/11/93;
* 34 07    S 136 22    E; Port Neill; 00/02/65-00/08/70
Y 32 36.10 S 133 59.50 E; GAB; 09/05/84-02/07/84;
Y 32 36.10 S 133 59.50 E; GAB; 14/07/84-10/09/84;
Y 32 36.10 S 133 59.50 E; GAB; 15/09/84-11/10/84;
Y 32 43.50 S 133 52.00 E; GAB; 14/07/84-09/09/84;
Y 32 43.50 S 133 52.00 E; GAB; 14/09/84-11/10/84;
Y 32 52.75 S 133 39.63 E; GAB; 15/05/84-25/05/84;
Y 32 52.75 S 133 39.63 E; GAB; 13/06/84-13/06/84;
Y 32 52.75 S 133 39.63 E; GAB; 05/06/84-06/06/84;
Z 33.1667  S 133.2817  E; GAB; 14/05/84-13/09/84;
Z 33.5533  S 132.8672  E; GAB; 14/05/84-11/10/84;
Z 33.9550  S 132.3900  E; GAB; 13/05/84-15/07/84;
Y 34 24.85 S 131 52.20 E; GAB; 13/05/84-15/07/84;
Y 34 24.85 S 131 52.20 E; GAB; 14/09/84-12/10/84;
Z 34.4333  S 131.8100  E; GAB; 13/05/84-01/10/84;
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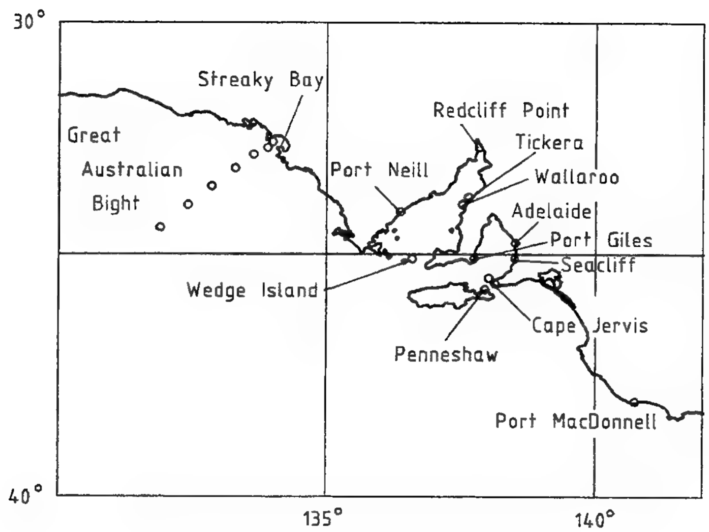
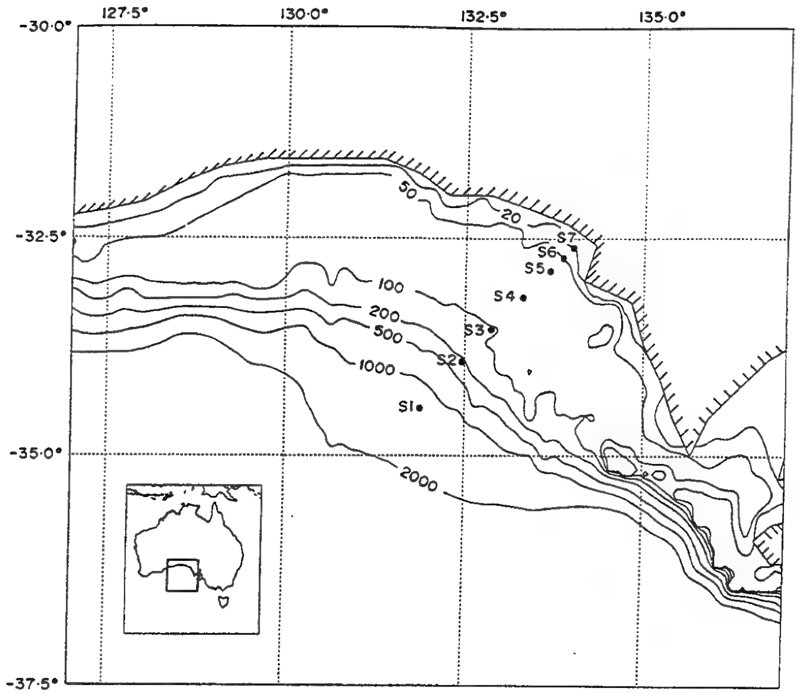


Fig 5.6. South Australia. Sites of historical waverider buoy measurements (Culver & Walker 19--; Young & Gorman 1995).



The study region in the Great Australian Bight. The water depth contours are marked in meters, and the measurement sites are labeled S1 to S7.

Locations and Details of Instrument Sites

Site	Latitude, °N	Longitude, °W	Water Depth, m	Distance from Site 1, km	Instrument Type
S1	−34°24.85′	131°52.20′	1150	0.00	Waverider
S2	−33°57.30′	132°23.44′	200	70.35	Waverider
S3	−33°33.21′	132°52.04′	100	133.15	Waverider
S4	−33°10.01′	133°16.85′	75	191.01	Waverider
S5	−32°52.75′	133°39.63′	63	238.73	Pressure
S6	−32°43.50′	133°52.00′	50	264.31	Waverider/Pressure-Current
S7	−32°36.10′	133°59.50′	26	281.64	Pressure

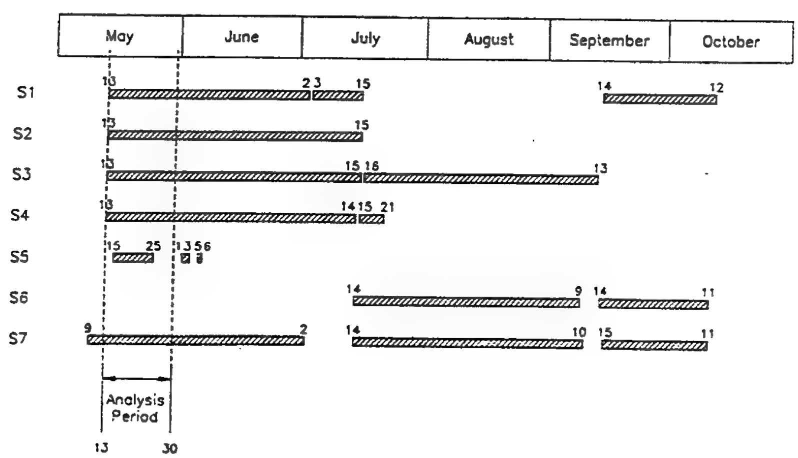


Table 5.6. South Australia. Details of waverider buoy deployments for selected sites of Fig 5.6 (Young & Gorman 1995).

5.7 South West Australia

The **WA Department of Transport** (previously Department of Marine and Harbours) hold waverider buoy data for sites shown in Fig 5.7. This information was provided to Andrew Walsh of the Australian Oceanographic Data Centre (AODC) by Grant Ryan. The Maritime Works Branch of the Dept of Housing and Construction A.C.T. (now the Department of Administrative Services) hold data for Cockburn Sound (MIAS 1982).

LIST OF SELECTED ARCHIVED WAVE DATA SITES
Site numbers are those of the Dept of Transport.

Note that a listing in this document for data or reports does not necessarily mean that the data or reports are available for public use or perusal, or that data or reports are free of charge. Requests for data or information should not be made to DSTO, but directly to the organisations which gathered the data.

1. Symbols used:
* = entries from the MIAS Catalogue Of Wave Data 1982.
^ = update to MIAS obtained in 1995
B = Bunbury Port Authority
D = DSTO (Jones et al 1995)
F = Fremantle Port Authority
K = Steedman report R399 (Brown and Morison 1988)
MAP = Position shown on map - exact co-ordinates unknown
R = Buchan and Russell (1987)
RKS = R.K. Steedman & Associates report (1976)
W = Dept of Transport W.A. (Coastal Information & Engineering Services)
(also see a following list for a re-ordering of these positions by site number)
Z = WNI Science & Engineering

```
SOUTH-WESTERN AUSTRALIA (alphabetically)
(NOTE: the next list by latitude has more entries)
SEE APPENDIX I FOR AN ALPHABETICAL LISTING OF ALL SITES KNOWN TO HAVE WAVE DETAILS

W 35 01 53 S 117 56 31 E; Albany; 24/06/81-12/09/83; site 15; 13 m
W 34 22 30 S 115 09 17 E; Augusta; 14/05/87-00/09/88; site 26; 8 m
W 34 21 59 S 115 10 10 E; Augusta; 02/09/88-22/02/90; site 30; 10 m
W 34 25 26 S 119 24 21 E; Bremer Bay; 22/05/92-12/12/93; site 34; 20 m
W 34 25 33 S 119 23 49 E; Bremer Bay; 22/05/92-12/12/93; site 35; 6 m
W 33 17 47 S 115 37 14 E; Bunbury; 05/03/75-02/07/75; site 3; 16 m
W 33 17 47 S 115 37 14 E; Bunbury; 02/07/75-03/06/76; site 3; 16 m
W 33 17 43 S 115 37 06 E; Bunbury; 19/04/77-19/06/78; site 8; 16 m
W 33 17 43 S 115 37 06 E; Bunbury; 09/08/78-05/10/78; site 8; 16 m
W 33 17 43 S 115 37 06 E; Bunbury; 05/10/78-23/03/79; site 8; 16 m
W 33 17 43 S 115 37 06 E; Bunbury; 22/05/79-02/05/80; site 8; 16 m
W 33 17 43 S 115 37 06 E; Bunbury; 12/05/80-12/06/80; site 8; 16 m
W 33 17 43 S 115 37 06 E; Bunbury; 12/06/80-12/12/81; site 8; 16 m
B 33 17 45 S 116 38 51 E; Bunbury; 01/09/96-99/99/99; wave pole
W 33 36 07 S 115 16 32 E; Busselton; 21/07/77-16/08/78; site 7; 14 m
W 33 36 07 S 115 16 32 E; Busselton; 16/08/78-07/12/78; site 7; 14 m
K MAP                    ; Cape Peron;; Steedman R399
* 32 13 55 S 115 41 52 E; Cockburn Sound; 01/07/70-16/09/72
```

```
* 32 11 38 S 115 32 22 E; Cockburn Sound; 07/07/70-26/01/75
* 32 08 12 S 115 40 32 E; Cockburn Sound; 07/07/70-29/07/72
F 32 12 00 S 115 44 05 E; Cockburn Sound; 15/02/96-99/99/99; wave pole
R 32 36.0  S 115 37.6  E; Dawesville; 04/09/85-06/11/85;
R 32 36.0  S 115 37.6  E; Dawesville; 15/11/85-09/01/86;
W 32 35 54 S 115 33 03 E; Dawesville; 16/04/85-23/10/86; site 22; 25 m
W 32 36 21 S 115 37 19 E; Dawesville; 16/04/85-24/08/85; site 23; 10 m
W 32 36 02 S 115 37 36 E; Dawesville; 16/04/85-23/10/86; site 24; 8 m
W 33 50 26 S 121 55 58 E; Esperance; 21/05/80-04/03/81; site 11; 12 m
W 33 56 00 S 121 57 30 E; Esperance; 11/08/82-10/03/83; site 16; 47 m
W 33 56 00 S 121 57 30 E; Esperance; 17/03/83-20/12/83; site 16; 47 m
W 34 19 39 S 115 12 46 E; Flinders Bay; 01/11/89-13/11/90; 13 m
F 32 01 14 S 115 37 35 E; Fremantle; 21/10/96-99/99/99; wave pole
F 32 03 27 S 115 43 25 E; Fremantle; 16/10/96-99/99/99; wave pole
F 32 07 52 S 115 42 02 E; Fremantle; 18/10/96-99/99/99; wave pole
W 32 03 44 S 115 43 29 E; Fremantle; 05/06/74-24/02/75; site 1; 7 m
K MAP                   ; Fremantle;; Steedman R399
W 32 48 00 S 115 41 48 E; Fremantle (Parmelia); 11/02/94-17/08/94; 7 m
W 32 58 48 S 115 41 21 E; Fremantle (deep); 17/08/94-99/99/99; 17 m
W 32 08    S 115 34    E; Garden Island offshore; 00/07/71-00/12/75; RKS
K MAP                   ; Garden Island west;; Steedman R399
W 28 45 28 S 114 34 12 E; Geraldton; 16/12/76-12/05/77 ; site 6; 10 m
W 28 45 28 S 114 34 12 E; Geraldton; 24/10/77-09/02/78; site 6; 10 m
W 28 45 22 S 114 34 01 E; Geraldton; 13/03/80-99/99/99; site 10; 12 m
W 28 45 32 S 114 32 28 E; Geraldton; 13/12/83-21/01/85; site 18; 27 m
W 28 45 30 S 114 35 01 E; Geraldton; 13/12/83-22/01/85; site 19; 10 m
W 28 45 55 S 114 35 55 E; Geraldton; 13/12/83-24/01/85; site 20; 6 m
W 31 24 17 S 115 25 40 E; Guilderton; 07/04/88-11/01/89; site 28; 33m
W 31 21 35 S 115 28 55 E; Guilderton; 07/04/88-11/01/89; site 29; 10 m
W 31 49 44 S 115 43 49 E; Hillarys; 31/03/87-20/05/87; site 25; 6 m
W 32 08 29 S 115 45 40 E; Jervoise Bay; 08/10/82-17/17/82; site 17; 10 m
W 32 08 29 S 115 45 40 E; Jervoise Bay; 20/01/83-07/07/83; site 17; 10 m
W 30 17 32 S 115 02 0.7E; Jurien Bay; 18/03/81-23/09/82; site 14; 11.5m; 31.6'S
W 32 14 17 S 115 45 16 E; Kwinana; 04/11/93-05/12/93; 10 m
W 31 46    S 115 43    E; Mullaloo offshore; 00/08/74-00/04/75; RKS
W 31 45 44 S 115 43 26 E; Mullaloo North; 26/05/77-03/03/78; site 9; 7 m
K MAP                   ; Mullaloo;; Steedman R399
W 21.8944  S 114.9292  E; Ningaloo; 07/08/87-01/11/88; site 27; 47 m
W 28 35 28 S 114 33 57 E; Oakajee River; 12/03/80-29/09/81; site 12; 15 m
D 32 15    S 115 02    E; Perth offshore; 22/07/92-30/08/92
W 29 15 43 S 114 50 50 E; Port Denison; 29/07/74-11/12/74; site 2; Paul 1976; 20 m
W 29 15 43 S 114 50 50 E; Port Denison; 14/07/75-31/08/75; site 2; Paul 1976; 20 m
W 29 16 22 S 114 54 21 E; Port Denison; 15/07/75-21/10/76; site 4; 14 m
W 29 16 21 S 114 54 51 E; Port Denison; 29/10/75-13/12/75; site 5; 8 m
W 29 16 21 S 114 54 51 E; Port Denison; 24/06/76-15/11/76; site 5; 8 m
W 33 32 58 S 115 03 34 E; Rocky Point; 14/03/79-18/10/79; site 13; 7 m
W 33 32 58 S 115 03 34 E; Rocky Point; 22/04/80-03/05/81; site 13; 7 m
K MAP                   ; Rottnest SSW;; Steedman R399
W 32 06 41 S 115 24 20 E; Rottnest; 27/07/91-99/99/99; site 33; 48 m
Z 32 07    S 115 18    E; Rottnest; 24/07/91-?; 120 m; RAN HMAS Stirling
W 31 49 36 S 115 46 36 E; Sorrento; 07/06/84-17/10/84; site 21; 8 m
```

SOUTHWEST AUSTRALIA (by latitude - also includes **WNI Science & Engineering SITES not in the above alphabetical listing (For WNI locations see Fig 6.1).**
SEE APPENDIX I FOR AN ALPHABETICAL LISTING OF ALL SITES KNOWN TO HAVE WAVE DETAILS

```
Z 28.2075  S 114.7267  E; see map; 06/11/81-14/10/82; information from WNI
Z 28.2094  S 114.8833  E; see map; 06/11/81-14/10/82; information from WNI
Z 28.5717  S 114.5450  E; see map; 26/06/82-04/07/83; information from WNI
W 28 35 28 S 114 33 57 E; Oakajee River; 12/03/80-29/09/81; site 12; 15 m
Z 28.7561  S 114.5669  E; see map; 22/02/84-14/01/85; information from WNI
Z 28.7583  S 114.5836  E; see map; 16/03/84-19/01/85; information from WNI
Z 28.7589  S 114.5411  E; see map; 16/03/84-19/01/85; information from WNI
Z 28.7653  S 114.5986  E; see map; 16/03/84-19/01/85; information from WNI
Z 28.7744  S 114.5581  E; see map; 28/06/89-21/11/90; information from WNI
W 28 45 22 S 114 34 01 E; Geraldton; 13/03/80-99/99/99; site 10; 12 m
W 28 45 28 S 114 34 12 E; Geraldton; 16/12/76-12/05/77 ; site 6; 10 m
W 28 45 28 S 114 34 12 E; Geraldton; 24/10/77-09/02/78; site 6; 10 m
W 28 45 30 S 114 35 01 E; Geraldton; 13/12/83-22/01/85; site 19; 10 m
W 28 45 32 S 114 32 28 E; Geraldton; 13/12/83-21/01/85; site 18; 27 m
W 28 45 55 S 114 35 55 E; Geraldton; 13/12/83-24/01/85; site 20; 6 m
W 29 15 43 S 114 50 50 E; Port Denison; 29/07/74-11/12/74; site 2; Paul 1976; 20 m
W 29 15 43 S 114 50 50 E; Port Denison; 14/07/75-31/08/75; site 2; Paul 1976; 20 m
W 29 16 21 S 114 54 51 E; Port Denison; 29/10/75-13/12/75; site 5; 8 m
W 29 16 21 S 114 54 51 E; Port Denison; 24/06/76-15/11/76; site 5; 8 m
W 29 16 22 S 114 54 21 E; Port Denison; 15/07/75-21/10/76; site 4; 14 m
```

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W 30 17 32 S 115 02 0.7E; Jurien Bay; 18/03/81-23/09/82; site 14; 11.5m; 31.6'S
W 31 21 35 S 115 28 55 E; Guilderton; 07/04/88-11/01/89; site 29; 10 m
W 31 24 17 S 115 25 40 E; Guilderton; 07/04/88-11/01/89; site 28; 33m
Z 31.6950   S 115.5550  E; see map; 13/07/87-14/10/87; information from WNI
Z 31.7333   S 115.5550  E; see map; 13/07/87-14/10/87; information from WNI
W 31 45 44 S 115 43 26 E; Mullaloo North; 26/05/77-03/03/78; site 9; 7 m
W 31 46    S 115 43    E; Mullaloo offshore; 00/08/74-00/04/75; RKS
K MAP                   ; Mullaloo;; Steedman R399
W 31 49 36 S 115 46 36 E; Sorrento; 07/06/84-17/10/84; site 21; 8 m
W 31 49 44 S 115 43 49 E; Hillarys; 31/03/87-20/05/87; site 25; 6 m
Z 31.8833   S 115.6750  E; see map; 27/05/86-17/02/87; information from WNI
Z 31.8925   S 115.6744  E; see map; 25/03/85-09/04/85; information from WNI
Z 31.9550   S 115.6750  E; see map; 04/06/93-21/06/93; information from WNI
Z 32.0230   S 115.6178  E; see map; 12/11/84-03/04/85; information from WNI
W 32 03 44 S 115 43 29 E; Fremantle; 05/06/74-24/02/75; site 1; 7 m
Z 32.0633   S 115.6083  E; see map; 19/09/90-05/10/90; information from WNI
Z 32.0847   S 115.7161  E; see map; 17/08/94-99/99/99; information from WNI
Z 32.0967   S 115.7000  E; see map; 30/10/86-18/12/86; information from WNI
Z 32.1033   S 115.7583  E; see map; 06/11/86-18/12/86; information from WNI
F 32 01 14 S 115 37 35 E; Fremantle; 21/10/96-99/99/99; wave pole
F 32 03 27 S 115 43 25 E; Fremantle; 16/10/96-99/99/99; wave pole
W 32 06 41 S 115 24 20 E; Rottnest; 27/07/91-99/99/99; site 33; 48 m
Z 32.1120   S 115.4020  E; see map; 04/08/94-20/12/94; information from WNI
Z 32 07     S 115 18    E; Rottnest; 24/07/91-?; 120 m; RAN HMAS Stirling
Z 32.1167   S 115.3000  E; see map; 16/05/91-17/10/91; information from WNI
Z 32.1167   S 115.3000  E; see map; 10/05/91-18/06/91; information from WNI
Z 32.1167   S 115.4333  E; see map; 27/05/86-17/02/87; information from WNI
Z 32.1117   S 115.4050  E; see map; 04/06/93-16/08/93; information from WNI
Z 32.1200   S 115.7583  E; see map; 30/10/86-19/12/86; information from WNI
Z 32.1217   S 115.4017  E; see map; 02/01/85-13/03/85; information from WNI
Z 32.1217   S 115.4017  E; see map; 04/10/85-27/05/86; information from WNI
W 32 08     S 115 34    E; Garden Island offshore; 00/07/71-00/12/75; RKS
F 32 07 52 S 115 42 02 E; Fremantle; 18/10/96-99/99/99; wave pole
Z 32.1347   S 115.7433  E; see map; 23/10/86-14/01/87; information from WNI
* 32 08 12 S 115 40 32 E; Cockburn Sound; 07/07/70-29/07/72
Z 32.1370   S 115.6983  E; see map; 12/07/93-18/08/93; information from WNI
W 32 08 29 S 115 45 40 E; Jervoise Bay; 08/10/82-17/17/82; site 17; 10 m
W 32 08 29 S 115 45 40 E; Jervoise Bay; 20/01/83-07/07/83; site 17; 10 m
Z 32.1583   S 115.7333  E; see map; 02/06/87-05/06/87; information from WNI
Z 32.1933   S 115.5417  E; see map; 11/08/87-14/10/87; information from WNI
* 32 11 38 S 115 32 22 E; Cockburn Sound; 07/07/70-26/01/75
F 32 12 00 S 115 44 05 E; Cockburn Sound; 15/02/96-99/99/99; wave pole
* 32 13 55 S 115 41 52 E; Cockburn Sound; 01/07/70-16/09/72
W 32 14 17 S 115 45 16 E; Kwinana; 04/11/93-05/12/93; 10 m
D 32 15     S 115 02    E; Perth offshore; 22/07/92-30/08/92
K MAP                   ; Cape Peron;; Steedman R399; approx 32 16 S
Z 32.2831   S 115.0286  E; see map; 22/07/92-30/08/92; information from WNI
Z 32.2889   S 115.5778  E; see map; 15/02/83-14/02/84; information from WNI
Z 32.2911   S 115.5367  E; see map; 29/03/82-04/12/82; information from WNI
Z 32.5983   S 115.5508  E; see map; 17/04/85-16/12/86; information from WNI
W 32 35 54 S 115 33 03 E; Dawesville; 16/04/85-23/10/86; site 22; 25 m
R 32 36.0   S 115 37.6  E; Dawesville; 04/09/85-06/11/85;
R 32 36.0   S 115 37.6  E; Dawesville; 15/11/85-09/01/86;
W 32 36 02 S 115 37 36 E; Dawesville; 16/04/85-23/10/86; site 24; 8 m
Z 32.6006   S 115.6267  E; see map; 17/04/85-24/04/87; information from WNI
Z 32.6058   S 115.6219  E; see map; 17/04/85-16/09/85; information from WNI
W 32 36 21 S 115 37 19 E; Dawesville; 16/04/85-24/08/85; site 23; 10 m
W 32 48 00 S 115 41 48 E; Fremantle (Parmelia); 11/02/94-17/08/94; 7 m
Z 32.8917   S 115.6750  E; see map; 12/12/83-29/03/85; information from WNI
Z 32.8917   S 115.7397  E; see map; 04/10/85-27/05/86; information from WNI
W 32 58 48 S 115 41 21 E; Fremantle (deep); 17/08/94-99/99/99; 17 m
K MAP                   ; Fremantle;; Steedman R399
K MAP                   ; Rottnest SSW;; Steedman R399
K MAP                   ; Garden Island west;; Steedman R399
W 33 17 43 S 115 37 06 E; Bunbury; 19/04/77-19/06/78; site 8; 16 m
W 33 17 43 S 115 37 06 E; Bunbury; 09/08/78-05/10/78; site 8; 16 m
W 33 17 43 S 115 37 06 E; Bunbury; 05/10/78-23/03/79; site 8; 16 m
W 33 17 43 S 115 37 06 E; Bunbury; 22/05/79-02/05/80; site 8; 16 m
W 33 17 43 S 115 37 06 E; Bunbury; 12/05/80-12/06/80; site 8; 16 m
W 33 17 43 S 115 37 06 E; Bunbury; 12/06/80-12/12/81; site 8; 16 m
B 33 17 45 S 116 38 51 E; Bunbury; 01/09/96-99/99/99; wave pole
W 33 17 47 S 115 37 14 E; Bunbury; 05/03/75-02/07/75; site 3; 16 m
W 33 17 47 S 115 37 14 E; Bunbury; 02/07/75-03/06/76; site 3; 16 m
W 33 32 58 S 115 03 34 E; Rocky Point; 14/03/79-18/10/79; site 13; 7 m
W 33 32 58 S 115 03 34 E; Rocky Point; 22/04/80-03/05/81; site 13; 7 m
W 33 36 07 S 115 16 32 E; Busselton; 21/07/77-16/08/78; site 7; 14 m
W 33 36 07 S 115 16 32 E; Busselton; 16/08/78-07/12/78; site 7; 14 m
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W 33 50 26 S 121 55 58 E; Esperance; 21/05/80-04/03/81; site 11; 12 m
W 33 56 00 S 121 57 30 E; Esperance; 11/08/82-10/03/83; site 16; 47 m
W 33 56 00 S 121 57 30 E; Esperance; 17/03/83-20/12/83; site 16; 47 m
W 34 19 39 S 115 12 46 E; Flinders Bay; 01/11/89-13/11/90; 13 m
W 34 21 59 S 115 10 10 E; Augusta; 02/09/88-22/02/90; site 30; 10 m
Z 34.3749  S 115.1546  E; see map; 15/06/87-15/06/87; information from WNI
Z 34.3749  S 115.1546  E; see map; 15/07/87-15/08/87; information from WNI
W 34 22 30 S 115 09 17 E; Augusta; 14/05/87-00/09/88; site 26; 8 m
W 34 25 26 S 119 24 21 E; Bremer Bay; 22/05/92-12/12/93; site 34; 20 m
W 34 25 33 S 119 23 49 E; Bremer Bay; 22/05/92-12/12/93; site 35; 6 m
W 35 01 53 S 117 56 31 E; Albany; 24/06/81-12/09/83; site 15; 13 m
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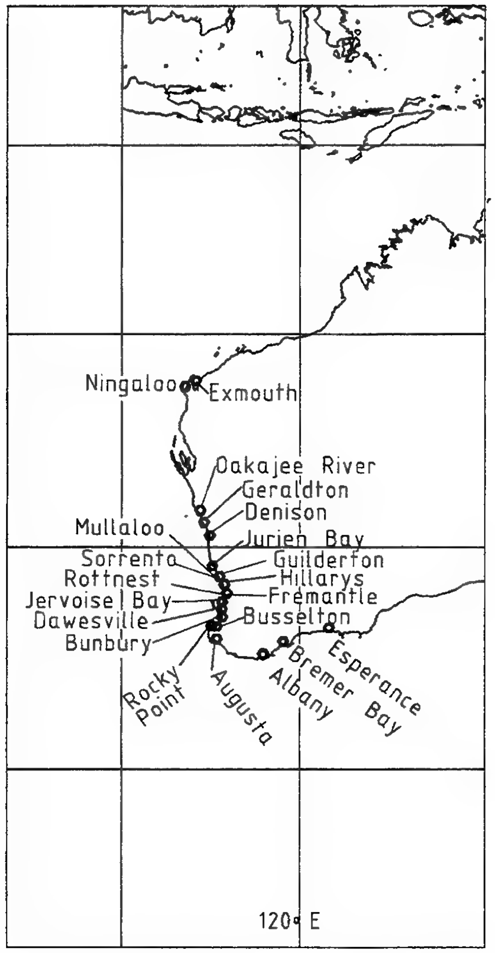

Fig. 5.7. South-western Australia historical waverider buoy locations (information from WA Department of Transport).

SPECIAL LISTING - INFORMATION PROVIDED BY COASTAL INFORMATION AND ENGINEERING SERVICES, WESTERN AUSTRALIA.

This list contains the Dept of Transport waverider deployment details listed in order of site number.

(See following page)

Department of Transport - Western Australia

Waverider Buoy Deployments

No.	Location Name	Lat			Long			Depth	Deployed	Retrieved
1	Fremantle	32	03	44	115	43	29	7	5-Jun-74	24-Feb-75
2	Port Denison	29	15	43	114	50	50	20	29-Jul-74	11-Dec-74
2	Port Denison	29	15	43	114	50	50	20	14-Jul-75	31-Aug-75
3	Bunbury	33	17	47	115	37	14	16	5-Mar-75	2-Jul-75
3	Bunbury	33	17	47	115	37	14	16	2-Jul-75	3-Jun-76
4	Port Denison	29	16	22	114	54	21	14	15-Jul-75	21-Oct-76
5	Port Denison	29	16	21	114	54	51	8	29-Oct-75	13-Dec-75
5	Port Denison	29	16	21	114	54	51	8	24-Jun-76	15-Nov-76
6	Geraldton	28	45	28	114	34	12	10	16-Dec-76	12-May-77
6	Geraldton	28	45	28	114	34	12	10	24-Oct-77	9-Feb-78
7	Busselton	33	36	07	115	16	32	14	21-Jul-77	16-Aug-78
7	Busselton	33	36	07	115	16	32	14	16-Aug-78	7-Dec-78
8	Bunbury	33	17	43	115	37	06	16	19-Apr-77	19-Jun-78
8	Bunbury	33	17	43	115	37	06	16	9-Aug-78	5-Oct-78
8	Bunbury	33	17	43	115	37	06	16	5-Oct-78	23-Mar-79
8	Bunbury	33	17	43	115	37	06	16	22-May-79	2-May-80
8	Bunbury	33	17	43	115	37	06	16	12-May-80	12-Jun-80
8	Bunbury	33	17	43	115	37	06	16	12-Jun-80	12-Dec-81
9	North Mullaloo	31	45	44	115	43	26	7	26-May-77	3-Mar-78
10	Geraldton (No longer DoTWA)	28	45	22	114	34	01	12	13-Mar-80	Still Deployed
11	Esperance	33	50	26	121	55	58	12	21-May-80	4-Mar-81
12	Oakajee River	28	35	28	114	33	57	15	12-Mar-80	29-Sep-81
13	Rocky Point	33	32	58	115	03	34	7	14-Mar-79	18-Oct-79
13	Rocky Point	33	32	58	115	03	34	7	22-Apr-80	3-May-81
14	Jurien Bay	30	17	32	115	02	01	12	18-Mar-81	23-Sep-82
15	Albany	35	01	53	117	56	31	13	24-Jun-81	12-Sep-83
16	Esperance	33	56	00	121	57	30	47	11-Aug-82	10-Mar-83
16	Esperance	33	56	00	121	57	30	47	17-Mar-83	20-Dec-83
17	Jervoise Bay	32	08	29	115	45	40	10	8-Oct-82	17-Dec-82
17	Jervoise Bay	32	08	29	115	45	40	10	20-Jan-83	7-Jul-83
18	Geraldton	28	45	32	114	32	28	27	13-Dec-83	21-Jan-85
19	Geraldton	28	45	30	114	35	01	10	13-Dec-83	21-Jan-85
20	Geraldton	28	45	55	114	35	55	6	13-Dec-83	21-Jan-85
21	Sorrento	31	49	36	115	46	36	8	7-Jun-84	17-Oct-84
22	Dawesville	32	35	54	115	33	03	25	16-Apr-85	23-Oct-86
23	Dawesville	32	36	21	115	37	19	10	16-Apr-85	24-Aug-85
24	Dawesville	32	36	02	115	37	36	8	16-Apr-85	23-Oct-86
25	Hillarys	31	49	44	115	43	49	6	31-Mar-87	20-May-87
26	Augusta	34	22	30	115	09	17	8	14-May-87	2-Sep-88
27	Ningaloo	21	53	40	113	55	45	47	7-Aug-87	1-Nov-88
28	Guilderton	31	24	17	115	25	40	33	7-Apr-88	11-Jan-89
29	Guilderton	31	21	35	115	28	55	10	7-Apr-88	11-Jan-89
30	Augusta	34	21	59	115	10	10	10	2-Sep-88	22-Feb-90
31	Exmouth	21	57	42	114	08	51	10	2-Nov-88	8-May-91
32	Flinders Bay	34	19	39	115	12	46	13	1-Nov-89	13-Nov-90
33	Rottnest	32	06	41	115	24	20	48	27-Jul-91	Still Deployed
34	Bremer Bay	34	25	26	119	24	21	20	22-May-92	12-Dec-93
35	Bremer Bay	34	25	33	119	23	49	6	22-May-92	12-Dec-93
36	Kwinana	32	14	17	115	45	16	10	4-Nov-93	5-Dec-93
37	Fremantle Parmelia Channel	32	48	00	115	41	48	7	11-Feb-94	17-Aug-94
38	Fremantle Deep Channel	32	58	48	115	41	21	17	17-Aug-94	Still Deployed

Table 5.7. South-western Australia historical waverider buoy deployment details (information from WA Department of Transport).

5.8 North West Shelf

A wave measurement programme was initiated in November 1972 using waverider buoys. Four-hourly visual sea state conditions have been taken and computerised at over 50 North West Shelf locations, with observations commencing for some locations in 1967 (Stroud and King 1975). Buchan and Stroud (1993) of **Steedman Science and Engineering** (now WNI Science & Engineering) provide a catalogue of selected wave data taken for the oil and gas industry by various contractors (for selected locations see Fig 5.8), and a brief review of wave conditions. A great deal of unreleased and unpublished oceanographic data are referenced in their report, and much more exists held by others. Some details are also available for data taken by other companies.

LIST OF SELECTED ARCHIVED WAVE DATA SITES FOR THE NORTH WEST SHELF

Note that a listing in this document for data or reports does not necessarily mean that the data or reports are available for public use or perusal, or that data or reports are free of charge. Requests for data or information should not be made to DSTO, but directly to the organisations which gathered the data.

1. Symbols used:
* = entries from the MIAS Catalogue Of Wave Data 1982.
^ = update to MIAS obtained in 1995
A = AIMS (Townsville)
DWR = Directional data
L = Lawson & Treloar
M = Maunsell and Partners (1981)
MAP = Position shown on map - exact co-ordinates unknown
R = Buchan and Russell (1987)
S = Buchan and Stroud (1993)
W = Dept of Transport W.A. (Coastal Information & Engineering Services)
Z = WNI Science & Engineering

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NORTH WEST SHELF (alphabetically) (most entries are from Buchan and Stroud 1993)
(does not include all entries in the following listing by latitude)
SEE APPENDIX I FOR AN ALPHABETICAL LISTING OF ALL SITES KNOWN TO HAVE WAVE DETAILS

S MAP                     ; Barrow Island (Tanker mooring); 00/04/82-00/04/83
S MAP                     ; Barrow Island south(Site 5 DWR); 00/02/84-00/04/84
S MAP                     ; Barrow Island south(Site 6); 00/02/84-00/04/84
S MAP                     ; Barrow Island south(Site 6 DWR); 00/02/84-00/04/84
S MAP                     ; Barrow Island south 7; 00/02/84-00/04/85
S                         ; Barrow Island west; 00/10/81-00/08/83
L 24 12     S 113 24     E; Cape Cuvier; 00/07/88-00/07/88; 10 m; pr; 4 days
M MAP                     ; Cape Lambert;;
S 20 27.3   S 116 42.7   E; Courtenay Head; 00/11/82-00/03/86; Buchan&Russell (1987)
S 20 27.3   S 116 42.7   E; Courtenay Head; 00/01/86-00/03/86; Buchan&Russell (1987)
S                         ; Dampier Archipelago Navaid 9 (DWR); 00/02/91-00/06/93
S                         ; Dampier station 4/80; 00/01/80-00/04/80
S MAP                     ; Dolphin Berth; 00/11/83-00/07/84
S MAP                     ; Dolphin Berth; 00/09/84-00/10/87
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W 21 57 42 S 114 08 51 E; Exmouth; 02/11/88-00/12/89; site 31; 10 m
A 21 50.802S 114 17.365E; Exmouth Gulf; 04/10/94-15/12/94; 20 m; with four S4s
^ 20 00     S 116 00    E; Exploration Wells; 01/12/72-?
S                        ; Fisher 1; 00/07/81-00/09/81
S MAP                    ; Goodwyn; 00/10/81-00/02/82
S MAP                    ; Goodwyn; 00/03/82-00/06/82
S MAP                    ; Harriet; 00/02/84-00/04/84
S MAP                    ; Jabiru (partly DWR); 00/10/83-00/02/93
S MAP                    ; Jabiru (long period); 00/06/84-00/05/85
S MAP                    ; Legendre Island; 00/06/80-00/12/82
- 20 23.4   S 116 41.2   ; Legendre Island; 01/01/82-31/12/82; 31 m; WNI
S MAP                    ; Legendre Island; 00/04/86-00/05/87
S MAP                    ; Legendre Island; 00/12/92-00/08/93
S MAP                    ; Legendre Island (DWR); 00/02/93-00/05/93
S                        ; Lowendal; 00/08/84-00/10/84
M MAP                    ; Mermaid Sound; Offshore site 1; Forde (1985)
M MAP                    ; Mermaid Sound; Offshore site 2; Forde (1985)
^ 20 35     S 116 45    E; Mermaid Sound; 01/12/72-?
^ 20 11     S 116 02    E; Mermaid Sound; 01/12/72-?
^ 19 32     S 116 09    E; North Rankin; 01/12/72-?
S MAP                    ; NRA; 00/04/83-00/06/85
S MAP                    ; NRA; 00/08/85-00/12/86
S MAP                    ; NRA; 00/01/88-?
S                        ; NRA 4; 00/01/82-00/12/82
S                        ; NRA 6; 00/04/81-00/07/81
S                        ; NRA 6; 00/08/81-00/10/81
L 20 00     S 118 26    E; Port Hedland C1; 00/12/84-00/03/85; 21 m
L 20 05     S 118 25    E; Port Hedland C3; 28/02/84-05/04/84; 21.5 m; pr; Rice(87)
L 20 05     S 118 25    E; Port Hedland C3; 00/12/84-00/03/85; 21.5 m; pr; Rice(87)
L 20 10.4   S 118 30.6  E; Port Hedland C5; 28/02/84-05/04/84; 16m; pr; Rice (1987)
- 20 10.8   S 116 41.2  E; Port Hedland; 01/01/92-31/12/92; 15 m; WNI
S                        ; ROWS buoys 1,2,3 (Dampier); 00/12/92-00/08/93
S                        ; ROWS buoys 1,2,3 (Dampier); 00/00/94-00/00/95
S                        ; ROWS buoys 1,2,3 (Dampier); 00/00/95-00/00/96
S MAP                    ; Saladin A; 00/12/85-00/04/86
S MAP                    ; Saladin A; 00/01/87-00/04/87
S MAP                    ; Skua; 00/08/91-00/09/92
S                        ; South Scott Reef; 00/02/82-00/05/82
S 20 31.6   S 116 43.7  E; Station A/B; 00/01/86-11/03/86
S MAP                    ; Talisman; 00/01/91-00/05/91
S                        ; Thevenard; ?-00/07/93
S MAP                    ; Thevenard channel; 00/11/89-?
S                        ; Thevenard deepwater; 00/12/85-00/04/86
S                        ; Thevenard deepwater; 00/01/87-00/04/87
S                        ; Thevenard deepwater; 00/10/87-00/02/88
S MAP                    ; Thevenard mooring; 00/12/85-00/04/86
S MAP                    ; Thevenard mooring; 00/01/87-00/10/87
S MAP                    ; Thevenard mooring; 00/01/88-00/05/88
S                        ; Thevenard pipeline (DWR); 00/01/87-00/04/87
S MAP                    ; Thevenard roller; 00/07/90-00/04/92
S MAP                    ; Thevenard roller DWR; 00/07/90-00/09/90
S MAP                    ; Thevenard roller DWR; 00/02/91-00/04/91
S MAP                    ; Wandoo; 00/03/92-00/11/92
S MAP                    ; Wandoo (DWR); 00/11/92-00/06/93
S MAP                    ; Withnell Bay; 00/06/80-00/12/87; Forde (1985)
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Other locations: Griffin Venture.

NORTH WEST SHELF (by latitude - does not include all the above alphabetical listing). These are mostly **WNI Science & Engineering sites (See Fig 6.1).**

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Z 11.7980   S 125.1590   E; see map; 31/03/84-12/05/86; information from WNI
Z 11.8111   S 125.3000   E; see map; 07/10/84-06/04/85; information from WNI
Z 11.8167   S 125.2000   E; see map; 31/03/84-07/10/84; information from WNI
Z 11.9258   S 125.0064   E; see map; 08/12/94-23/05/94; information from WNI
Z 11.9258   S 125.0064   E; see map; 20/06/94-01/01/95; information from WNI
Z 11.9333   S 125.0000   E; see map; 31/12/89-06/05/90; information from WNI
Z 11.9333   S 125.0000   E; see map; 15/11/88-31/12/89; information from WNI
Z 11.9333   S 125.0000   E; see map; 02/06/86-20/03/89; information from WNI
Z 12.5067   S 124.4217   E; see map; 25/08/91-27/02/92; information from WNI
Z 12.5072   S 124.4211   E; see map; 23/11/91-99/99/99; information from WNI
Z 12.5717   S 124.4767   E; see map; 01/01/92-26/01/93; information from WNI
Z 12.9333   S 128.5667   E; see map; 23/11/81-27/02/82; information from WNI
Z 13.6624   S 123.9558   E; see map; 25/02/90-09/04/90; information from WNI
Z 13.9483   S 121.9750   E; see map; 04/02/81-21/05/81; information from WNI

Z 19.4900   S 117.0000   E; see map; 01/01/94-01/01/95; information from WNI
^ 19 32     S 116 09     E; North Rankin; 01/12/72-?
Z 19.5842   S 116.1367   E; see map; 01/01/94-01/01/95; information from WNI
Z 19.5842   S 116.1367   E; see map; 11/05/94-26/08/94; information from WNI
Z 19.5842   S 116.1367   E; see map; 01/01/90-31/12/90; information from WNI
Z 19.5914   S 116.1174   E; see map; 08/12/93-31/12/94; information from WNI
Z 19.5974   S 116.1254   E; see map; 02/03/83-04/01/84; information from WNI
Z 19.5983   S 116.1167   E; see map; 26/09/89-04/05/91; information from WNI
Z 19.6140   S 116.1254   E; see map; 12/12/84-25/06/85; information from WNI
Z 19.6140   S 116.1254   E; see map; 04/01/84-11/04/84; information from WNI
Z 19.7000   S 115.8000   E; see map; 09/10/81-31/01/82; information from WNI
Z 19.7000   S 116.1880   E; see map; 28/01/80-10/04/80; information from WNI
Z 19.7500   S 118.8500   E; see map; 18/03/82-10/04/82; information from WNI
Z 19.7561   S 115.8889   E; see map; 07/01/86-29/04/86; information from WNI

^ 20 00     S 116 00     E; Exploration Wells; 01/12/72-?
L 20 00     S 118 26     E; Port Hedland C1; 00/12/84-00/03/85; 21 m
Z 20.0167   S 118.4050   E; see map; 02/05/85-03/11/85; information from WNI
Z 20.0514   S 116.5014   E; see map; 19/07/82-28/09/82; information from WNI
Z 20.0767   S 114.7267   E; see map; 13/05/82-11/08/82; information from WNI
L 20 05     S 118 25     E; Port Hedland C3; 28/02/84-05/04/84; 21.5 m; pr; Rice(87)
L 20 05     S 118 25     E; Port Hedland C3; 00/12/84-00/03/85; 21.5 m; pr; Rice(87)
- 20.1215   S 116.4163   E; Wandoo; ?/?/96-01/02/97
Z 20.1290   S 116.4340   E; see map; 27/12/93-25/08/94; information from WNI
Z 20.1367   S 118.4717   E; see map; 02/05/85-02/08/85; information from WNI
L 20 10.4   S 118 30.6   E; Port Hedland C5; 28/02/84-05/04/84; 16m; pr; Rice (1987)
Z 20.1750   S 114.0333   E; see map; 30/10/81-14/01/82; information from WNI
- 20 10.8   S 116 41.2   E; Port Hedland; 01/01/92-31/12/92; 15 m; WNI
Z 20.1806   S 118.5056   E; see map; 01/06/87-01/12/94; information from WNI
^ 20 11     S 116 02     E; Mermaid Sound; 01/12/72-?
Z 20.2067   S 116.3983   E; see map; 01/07/93-15/12/93; information from WNI
Z 20.2267   S 118.5467   E; see map; 11/11/85-29/08/86; information from WNI
Z 20.2267   S 118.5467   E; see map; 10/06/85-03/11/85; information from WNI
Z 20.2378   S 116.6333   E; see map; 23/06/82-19/07/82; information from WNI
Z 20.2600   S 118.5700   E; see map; 02/08/85-03/11/85; information from WNI
Z 20.2844   S 116.6842   E; see map; 11/11/82-17/12/82; information from WNI
Z 20.3067   S 114.9317   E; see map; 22/01/83-23/05/83; information from WNI
Z 20.3342   S 114.8964   E; see map; 12/08/82-13/02/83; information from WNI
Z 20.3350   S 116.8100   E; see map; 05/06/80-21/06/81; information from WNI
Z 20.3506   S 116.7761   E; see map; 25/05/82-23/06/82; information from WNI
Z 20.3778   S 116.7611   E; see map; 26/11/86-13/05/87; information from WNI
Z 20.3778   S 116.7583   E; see map; 11/04/86-04/12/86; information from WNI
Z 20.3800   S 116.7611   E; see map; 24/03/87-13/05/87; information from WNI
- 20 23.4   S 116 41.2    ; Legendre Island; 01/01/82-31/12/82; 31 m; WNI
Z 20.4250   S 114.8097   E; see map; 23/05/83-23/08/83; information from WNI
Z 20.4367   S 115.8850   E; see map; 08/02/94-24/06/94; information from WNI
S 20 27.3   S 116 42.7   E; Courtenay Head; 00/11/82-00/03/86; Buchan&Russell (1987)
S 20 27.3   S 116 42.7   E; Courtenay Head; 00/01/86-00/03/86; Buchan&Russell (1987)
Z 20.4567   S 116.7133   E; see map; 06/12/83-00/12/87; information from WNI
Z 20.4567   S 116.7133   E; see map; 09/12/82-08/02/84; information from WNI
Z 20.5233   S 116.7294   E; see map; 16/01/86-14/01/87; information from WNI
S 20 31.6   S 116 43.7   E; Station A/B; 00/01/86-11/03/86
Z 20.5792   S 116.7639   E; see map; 00/06/80-00/12/87; information from WNI
Z 20.5792   S 116.7639   E; see map; 30/09/87-12/12/87; information from WNI
Z 20.5833   S 116.7517   E; see map; 05/06/80-21/06/81; information from WNI
^ 20 35     S 116 45     E; Mermaid Sound; 01/12/72-?
Z 20.5850   S 116.7600   E; see map; 09/12/82-08/02/84; information from WNI
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Z 20.5867  S 116.7583  E; see map; 06/12/83-06/01/87; information from WNI
Z 20.5867  S 116.7583  E; see map; 15/01/86-11/03/86; information from WNI
Z 20.5950  S 115.5925  E; see map; 08/02/84-19/04/84; information from WNI
Z 20.6250  S 116.7483  E; see map; 01/11/84-22/12/86; information from WNI
Z 20.6562  S 115.3508  E; see map; 29/03/94-19/08/94; information from WNI
Z 20.6562  S 115.3508  E; see map; 30/03/94-18/08/94; information from WNI
Z 20.7072  S 115.5883  E; see map; 30/08/84-16/10/84; information from WNI
Z 20.8144  S 115.5511  E; see map; 19/04/82-16/04/83; information from WNI

Z 21.1250  S 115.2550  E; see map; 24/02/84-13/04/85; information from WNI
Z 21.1900  S 114.8983  E; see map; 30/01/82-13/05/82; information from WNI
Z 21.2000  S 115.1117  E; see map; 30/07/84-27/02/85; information from WNI
Z 21.2183  S 115.1417  E; see map; 24/02/84-27/06/84; information from WNI
Z 21.2200  S 115.1522  E; see map; 28/02/85-12/04/85; information from WNI
Z 21.2533  S 114.6333  E; see map; 20/12/93-20/09/94; information from WNI
Z 21.2567  S 114.9517  E; see map; 22/01/87-28/04/87; information from WNI
Z 21.2567  S 114.9517  E; see map; 22/10/87-29/01/88; information from WNI
Z 21.2633  S 114.9400  E; see map; 20/12/85-01/05/86; information from WNI
Z 21.3567  S 114.9350  E; see map; 09/06/94-15/12/94; information from WNI
Z 21.3933  S 114.9300  E; see map; 04/12/89-24/11/93; information from WNI
Z 21.4000  S 115.3533  E; see map; 22/01/87-28/04/87; information from WNI
Z 21.4033  S 115.0600  E; see map; 20/12/85-01/05/86; information from WNI
Z 21.4050  S 115.0600  E; see map; 22/01/87-03/05/88; information from WNI
Z 21.4067  S 114.9350  E; see map; 24/12/93-12/05/94; information from WNI
Z 21.4383  S 115.2317  E; see map; 25/05/94-99/99/99; information from WNI
Z 21.4416  S 115.0532  E; see map; 20/12/85-00/12/87; information from WNI
Z 21.4417  S 115.0567  E; see map; 22/01/87-28/04/87; information from WNI
Z 21.5617  S 115.3306  E; see map; 17/05/94-28/06/94; information from WNI
Z 21.6064  S 114.9614  E; see map; 14/10/90-19/12/90; information from WNI
Z 21.6305  S 114.9225  E; see map; 19/10/91-11/04/92; information from WNI
Z 21.6350  S 114.9258  E; see map; 03/08/90-19/10/91; information from WNI
A 21 50.802S 114 17.365E; Exmouth Gulf; 04/10/94-15/12/94; 20 m; with four S4s
Z 21.8944  S 114.9292  E; see map; 12/08/87-31/08/87; information from WNI
W 21.8944  S 114.9292  E; Ningaloo; 07/08/87-01/11/88; site 27; 47 m
W 21 57 42 S 114 08 51 E; Exmouth; 02/11/88-00/12/89; site 31; 10 m

L 24 12    S 113 24    E; Cape Cuvier; 00/07/88-00/07/88; 10 m; pr; 4 days
```

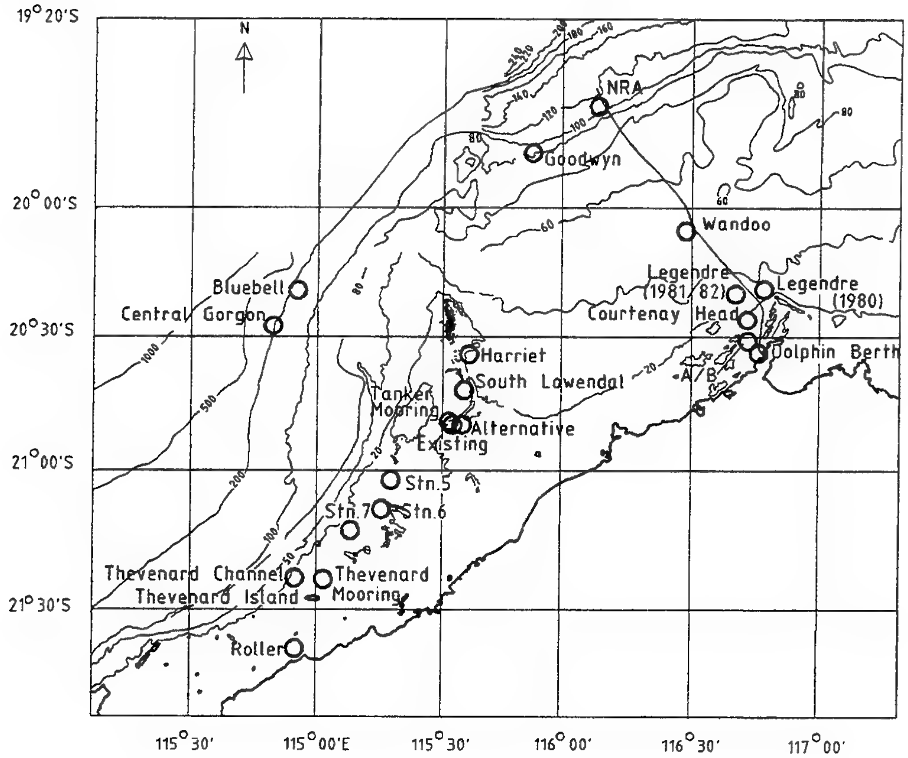

Fig. 5.8. North West Shelf waverider buoy location history (information from Buchan and Stroud 1993; WeatherNews Inc).

NOTE THAT A LISTING IN THIS DOCUMENT FOR DATA OR REPORTS DOES NOT NECESSARILY MEAN THAT THE DATA OR REPORTS ARE AVAILABLE FOR PUBLIC USE OR PERUSAL, OR THAT DATA OR REPORTS ARE FREE OF CHARGE. REQUESTS FOR DATA OR INFORMATION SHOULD NOT BE MADE TO DSTO, BUT DIRECTLY TO THE ORGANISATIONS WHICH GATHERED THE DATA.

NOTE: If you have data information or reports that could be listed in this document, please send details to the author at Aeronautical and Maritime Research Laboratory, DSTO, P.O. Box 44, Pyrmont, NSW 2009, AUSTRALIA (preferably on a DOS diskette in ASCII or WORD for Windows format; or email ASCII text to les.hamilton@dsto.defence.gov.au).

5.9 Northern Territory

A wave buoy was installed off Larrakeyah (Fig 5.9) for 5 years from 1979 (Byrne 1987). The MIAS catalogue gives the contact as the Maritime Works Branch, Department of Housing and Construction, A.C.T. (now the Department of Administrative Services).

Note that a listing in this document for data or reports does not necessarily mean that the data or reports are available for public use or perusal, or that data or reports are free of charge. Requests for data or information should not be made to DSTO, but directly to the organisations which gathered the data.

```
* = MIAS catalogue entry
DWR = directional
Y = Prof Ian Young, Dept Civil and Maritime Engineering, University College, NSW. See CSIRO Research Summary FR9/95 for ORV Franklin. Maritime Continental Thunderstorms Experiment (MCTEX) Air-Sea Interactions.
Z = WNI Science & Engineering
```

```
NORTHERN TERRITORY
SEE APPENDIX I FOR AN ALPHABETICAL LISTING OF ALL SITES KNOWN TO HAVE WAVE DETAILS

* 12 27 54 S 130 49 18 E; Darwin; 16/02/78-20/02/82
Y 11 30.4  S 130 01.46 E; Bathurst Island (west of); 30/11/95-05/12/95; 27 m; DWR
Y 11 59.5  S 130 26.5  E; Beagle Gulf; 21/11/95-30/11/95; 33 m; DWR
Z 10.6950  S 133.1750  E; see Fig 6.1; 03/11/82-07/12/82; information from WNI
```

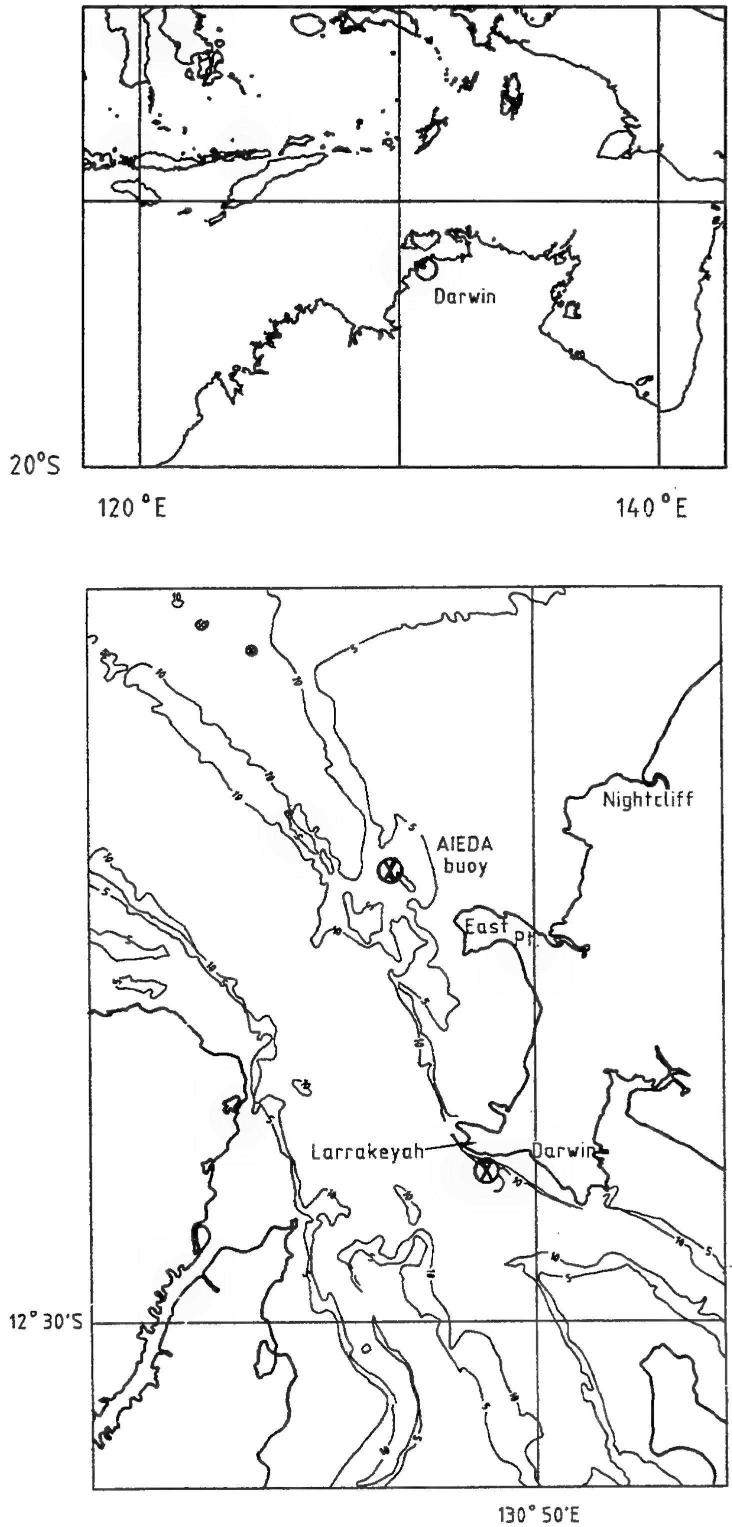

Fig. 5.9. Northern Territory historical waverider buoy location at Larrakeyah. Short term measurements have also been made in Beagle Gulf.

5.10 New Guinea

MIAS (1982) lists a WABO Power Development site at Kerema (Fig 5.10), with data (then) held by the Director of Navigational Affairs of the Dept of Transport, Works and Supply, New Guinea.

Note that a listing in this document for data or reports does not necessarily mean that the data or reports are available for public use or perusal, or that data or reports are free of charge. Requests for data or information should not be made to DSTO, but directly to the organisations which gathered the data.

```
* = MIAS catalogue entry
L = Lawson & Treloar

PAPUA NEW GUINEA (by latitude)
SEE APPENDIX I FOR AN ALPHABETICAL LISTING OF ALL SITES KNOWN TO HAVE WAVE DETAILS

L 06 20    S 155 25    E; Empress August Bay, Bougainville; 00/06/85-00/11/85; 60m
L 06 24    S 155 30    E; Empress August Bay, Bougainville; 00/08/85-00/11/85; 5 m
* 08 04 35 S 145 38 40 E; Kerema; 28/04/76-31/08/79
L 08 05    S 144 34    E; Kumul Platform; 00/06/92-00/08/92; 23 m; Directional
```

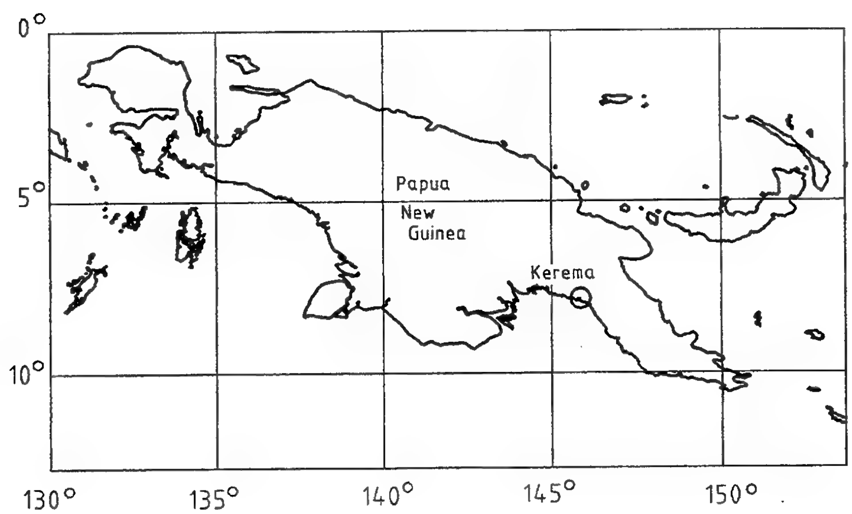

Fig. 5.10. New Guinea historical waverider buoy location at Kerema.

6. HISTORICAL WAVE DATA LOCATIONS - PRIVATE CONTRACTORS

The two major contractors involved in the collection of wave data round Australia's coasts have contributed lists of their wave data holdings for this bibliography. WNI Science & Engineering of Perth are principally involved in operations on the west coast, and Lawson & Treloar Pty Ltd of Sydney principally work on the east coast. These lists have greatly enhanced the usefulness of the present document, and it is hoped that more contractors will follow suit and provide some public form of their holdings in the future. The listings have been incorporated into the previous listings by state, but are shown separately to emphasise the contractor contributions and for easier location of data sources.

6.1 WNI Science & Engineering

SPECIAL LISTING - INFORMATION PROVIDED BY WNI SCIENCE & ENGINEERING (a division of WEATHERNEWS PTY LTD), PERTH, WESTERN AUSTRALIA. DATA DETAILS TO JANUARY 1995. REQUESTS FOR INFORMATION ON THE WNI DATA SHOULD BE MADE DIRECTLY TO WNI.

WNI Science & Engineering
A division of Weathernews Pty Ltd
31 Bishop Street, Jolimont WA 6014

Note that a listing in this document for data or reports does not necessarily mean that the data or reports are available for public use or perusal, or that data or reports are free of charge. Requests for data or information should not be made to DSTO, but directly to the organisations which gathered the data.

General locations are shown in Fig 6.1

```
LATITUDE   LONGITUDE              START & END DATES

NORTHERN TERRITORY
Z 10.6950  S 133.1750  E; see map; 03/11/82-07/12/82; information from WNI

QUEENSLAND
Z 14.6067  S 145.6050  E; see map; 19/08/85-19/09/85; information from WNI
Z 19.0517  S 148.6812  E; see map; 22/02/89-04/05/89; information from WNI

BASS STRAIT
Z 38.3153  S 148.6361  E; see map; 28/03/82-21/04/82; information from WNI
Z 38.1341  S 148.8080  E; see map; 08/04/82-22/04/82; information from WNI

SOUTH AUSTRALIA
Z 34.4333  S 131.8100  E; see map; 13/05/84-01/10/84; information from WNI
Z 33.9550  S 132.3900  E; see map; 13/05/84-15/07/84; information from WNI
Z 33.5533  S 132.8672  E; see map; 14/05/84-11/10/84; information from WNI
Z 33.1667  S 133.2817  E; see map; 14/05/84-13/09/84; information from WNI
Z 35.1117  S 136.5633  E; see map; 22/10/93-22/11/93; information from WNI
Z 33.8281  S 137.6200  E; see map; 15/01/83-13/04/84; information from WNI
```

NORTHWEST SHELF

Z 11.7980	S 125.1590	E;	see map;	31/03/84-12/05/86;	information from WNI
Z 11.8111	S 125.3000	E;	see map;	07/10/84-06/04/85;	information from WNI
Z 11.8167	S 125.2000	E;	see map;	31/03/84-07/10/84;	information from WNI
Z 11.9258	S 125.0064	E;	see map;	08/12/94-23/05/94;	information from WNI
Z 11.9258	S 125.0064	E;	see map;	20/06/94-01/01/95;	information from WNI
Z 11.9333	S 125.0000	E;	see map;	31/12/89-06/05/90;	information from WNI
Z 11.9333	S 125.0000	E;	see map;	15/11/88-31/12/89;	information from WNI
Z 11.9333	S 125.0000	E;	see map;	02/06/86-20/03/89;	information from WNI
Z 12.5067	S 124.4217	E;	see map;	25/08/91-27/02/92;	information from WNI
Z 12.5072	S 124.4211	E;	see map;	23/11/91-99/99/99;	information from WNI
Z 12.5717	S 124.4767	E;	see map;	01/01/92-26/01/93;	information from WNI
Z 12.9333	S 128.5667	E;	see map;	23/11/81-27/02/82;	information from WNI
Z 13.6624	S 123.9558	E;	see map;	25/02/90-09/04/90;	information from WNI
Z 13.9483	S 121.9750	E;	see map;	04/02/81-21/05/81;	information from WNI

Z 19.4900	S 117.0000	E;	see map;	01/01/94-01/01/95;	information from WNI
Z 19.5842	S 116.1367	E;	see map;	01/01/94-01/01/95;	information from WNI
Z 19.5842	S 116.1367	E;	see map;	11/05/94-26/08/94;	information from WNI
Z 19.5842	S 116.1367	E;	see map;	01/01/90-31/12/90;	information from WNI
Z 19.5914	S 116.1174	E;	see map;	08/12/93-31/12/94;	information from WNI
Z 19.5974	S 116.1254	E;	see map;	02/03/83-04/01/84;	information from WNI
Z 19.5983	S 116.1167	E;	see map;	26/09/89-04/05/91;	information from WNI
Z 19.6140	S 116.1254	E;	see map;	12/12/84-25/06/85;	information from WNI
Z 19.6140	S 116.1254	E;	see map;	04/01/84-11/04/84;	information from WNI
Z 19.7000	S 115.8000	E;	see map;	09/10/81-31/01/82;	information from WNI
Z 19.7000	S 116.1880	E;	see map;	28/01/80-10/04/80;	information from WNI
Z 19.7500	S 118.8500	E;	see map;	18/03/82-10/04/82;	information from WNI
Z 19.7561	S 115.8889	E;	see map;	07/01/86-29/04/86;	information from WNI

Z 20.0167	S 118.4050	E;	see map;	02/05/85-03/11/85;	information from WNI
Z 20.0514	S 116.5014	E;	see map;	19/07/82-28/09/82;	information from WNI
Z 20.0767	S 114.7267	E;	see map;	13/05/82-11/08/82;	information from WNI
Z 20.1290	S 116.4340	E;	see map;	27/12/93-25/08/94;	information from WNI
Z 20.1367	S 118.4717	E;	see map;	02/05/85-02/08/85;	information from WNI
Z 20.1750	S 114.0333	E;	see map;	30/10/81-14/01/82;	information from WNI
Z 20.1806	S 118.5056	E;	see map;	01/06/87-01/12/94;	information from WNI
Z 20.2067	S 116.3983	E;	see map;	01/07/93-15/12/93;	information from WNI
Z 20.2267	S 118.5467	E;	see map;	11/11/85-29/08/86;	information from WNI
Z 20.2267	S 118.5467	E;	see map;	10/06/85-03/11/85;	information from WNI
Z 20.2378	S 116.6333	E;	see map;	23/06/82-19/07/82;	information from WNI
Z 20.2600	S 118.5700	E;	see map;	02/08/85-03/11/85;	information from WNI
Z 20.2844	S 116.6842	E;	see map;	11/11/82-17/12/82;	information from WNI
Z 20.3067	S 114.9317	E;	see map;	22/01/83-23/05/83;	information from WNI
Z 20.3342	S 114.8964	E;	see map;	12/08/82-13/02/83;	information from WNI
Z 20.3350	S 116.8100	E;	see map;	05/06/80-21/06/81;	information from WNI
Z 20.3506	S 116.7761	E;	see map;	25/05/82-23/06/82;	information from WNI
Z 20.3778	S 116.7611	E;	see map;	26/11/86-13/05/87;	information from WNI
Z 20.3778	S 116.7583	E;	see map;	11/04/86-04/12/86;	information from WNI
Z 20.3800	S 116.7611	E;	see map;	24/03/87-13/05/87;	information from WNI
Z 20.4250	S 114.8097	E;	see map;	23/05/83-23/08/83;	information from WNI
Z 20.4367	S 115.8850	E;	see map;	08/02/94-24/06/94;	information from WNI
Z 20.4567	S 116.7133	E;	see map;	06/12/83-00/12/87;	information from WNI
Z 20.4567	S 116.7133	E;	see map;	09/12/82-08/02/84;	information from WNI
Z 20.5233	S 116.7294	E;	see map;	16/01/86-14/01/87;	information from WNI
Z 20.5792	S 116.7639	E;	see map;	00/06/80-00/12/87;	information from WNI
Z 20.5792	S 116.7639	E;	see map;	30/09/87-12/12/87;	information from WNI
Z 20.5833	S 116.7517	E;	see map;	05/06/80-21/06/81;	information from WNI
Z 20.5850	S 116.7600	E;	see map;	09/12/82-08/02/84;	information from WNI
Z 20.5867	S 116.7583	E;	see map;	06/12/83-06/01/87;	information from WNI
Z 20.5867	S 116.7583	E;	see map;	15/01/86-11/03/86;	information from WNI
Z 20.5950	S 115.5925	E;	see map;	08/02/84-19/04/84;	information from WNI
Z 20.6250	S 116.7483	E;	see map;	01/11/84-22/12/86;	information from WNI
Z 20.6562	S 115.3508	E;	see map;	29/03/94-19/08/94;	information from WNI
Z 20.6562	S 115.3508	E;	see map;	30/03/94-18/08/94;	information from WNI
Z 20.7072	S 115.5883	E;	see map;	30/08/84-16/10/84;	information from WNI
Z 20.8144	S 115.5511	E;	see map;	19/04/82-16/04/83;	information from WNI

Z 21.1250	S 115.2550	E;	see map;	24/02/84-13/04/85;	information from WNI
Z 21.1900	S 114.8983	E;	see map;	30/01/82-13/05/82;	information from WNI
Z 21.2000	S 115.1117	E;	see map;	30/07/84-27/02/85;	information from WNI
Z 21.2183	S 115.1417	E;	see map;	24/02/84-27/06/84;	information from WNI
Z 21.2200	S 115.1522	E;	see map;	28/02/85-12/04/85;	information from WNI
Z 21.2533	S 114.6333	E;	see map;	20/12/93-20/09/94;	information from WNI
Z 21.2567	S 114.9517	E;	see map;	22/01/87-28/04/87;	information from WNI

Z 21.2567	S 114.9517	E; see map;	22/10/87-29/01/88;	information from WNI
Z 21.2633	S 114.9400	E; see map;	20/12/85-01/05/86;	information from WNI
Z 21.3567	S 114.9350	E; see map;	09/06/94-15/12/94;	information from WNI
Z 21.3933	S 114.9300	E; see map;	04/12/89-24/11/93;	information from WNI
Z 21.4000	S 115.3533	E; see map;	22/01/87-28/04/87;	information from WNI
Z 21.4033	S 115.0600	E; see map;	20/12/85-01/05/86;	information from WNI
Z 21.4050	S 115.0600	E; see map;	22/01/87-03/05/88;	information from WNI
Z 21.4067	S 114.9350	E; see map;	24/12/93-12/05/94;	information from WNI
Z 21.4416	S 115.0532	E; see map;	20/12/85-00/12/87;	information from WNI
Z 21.4417	S 115.0567	E; see map;	22/01/87-28/04/87;	information from WNI
Z 21.4383	S 115.2317	E; see map;	25/05/94-99/99/99;	information from WNI
Z 21.5617	S 115.3306	E; see map;	17/05/94-28/06/94;	information from WNI
Z 21.6064	S 114.9614	E; see map;	14/10/90-19/12/90;	information from WNI
Z 21.6305	S 114.9225	E; see map;	19/10/91-11/04/92;	information from WNI
Z 21.6350	S 114.9258	E; see map;	03/08/90-19/10/91;	information from WNI
Z 21.8944	S 114.9292	E; see map;	12/08/87-31/08/87;	information from WNI
SOUTHWEST AUSTRALIA				
Z 28.2075	S 114.7267	E; see map;	06/11/81-14/10/82;	information from WNI
Z 28.2094	S 114.8833	E; see map;	06/11/81-14/10/82;	information from WNI
Z 28.5717	S 114.5450	E; see map;	26/06/82-04/07/83;	information from WNI
Z 28.7561	S 114.5669	E; see map;	22/02/84-14/01/85;	information from WNI
Z 28.7583	S 114.5836	E; see map;	16/03/84-19/01/85;	information from WNI
Z 28.7589	S 114.5411	E; see map;	16/03/84-19/01/85;	information from WNI
Z 28.7653	S 114.5986	E; see map;	16/03/84-19/01/85;	information from WNI
Z 28.7744	S 114.5581	E; see map;	28/06/89-21/11/90;	information from WNI
Z 31.6950	S 115.5550	E; see map;	13/07/87-14/10/87;	information from WNI
Z 31.7333	S 115.5550	E; see map;	13/07/87-14/10/87;	information from WNI
Z 31.8833	S 115.6750	E; see map;	27/05/86-17/02/87;	information from WNI
Z 31.8925	S 115.6744	E; see map;	25/03/85-09/04/85;	information from WNI
Z 31.9550	S 115.6750	E; see map;	04/06/93-21/06/93;	information from WNI
Z 32.0230	S 115.6178	E; see map;	12/11/84-03/04/85;	information from WNI
Z 32.0633	S 115.6083	E; see map;	19/09/90-05/10/90;	information from WNI
Z 32.0847	S 115.7161	E; see map;	17/08/94-99/99/99;	information from WNI
Z 32.0967	S 115.7000	E; see map;	30/10/86-18/12/86;	information from WNI
Z 32.1033	S 115.7583	E; see map;	06/11/86-18/12/86;	information from WNI
Z 32.1120	S 115.4020	E; see map;	04/08/94-20/12/94;	information from WNI
Z 32.1167	S 115.3000	E; see map;	16/05/91-17/10/91;	information from WNI
Z 32.1167	S 115.3000	E; see map;	10/05/91-18/06/91;	information from WNI
Z 32.1167	S 115.4333	E; see map;	27/05/86-17/02/87;	information from WNI
Z 32.1117	S 115.4050	E; see map;	04/06/93-16/08/93;	information from WNI
Z 32.1200	S 115.7583	E; see map;	30/10/86-19/12/86;	information from WNI
Z 32.1217	S 115.4017	E; see map;	02/01/85-13/03/85;	information from WNI
Z 32.1217	S 115.4017	E; see map;	04/10/85-27/05/86;	information from WNI
Z 32.1347	S 115.7433	E; see map;	23/10/86-14/01/87;	information from WNI
Z 32.1370	S 115.6983	E; see map;	12/07/93-18/08/93;	information from WNI
Z 32.1583	S 115.7333	E; see map;	02/06/87-05/06/87;	information from WNI
Z 32.1933	S 115.5417	E; see map;	11/08/87-14/10/87;	information from WNI
Z 32.2831	S 115.0286	E; see map;	22/07/92-30/08/92;	information from WNI
Z 32.2889	S 115.5778	E; see map;	15/02/83-14/02/84;	information from WNI
Z 32.2911	S 115.5367	E; see map;	29/03/82-04/12/82;	information from WNI
Z 32.5983	S 115.5508	E; see map;	17/04/85-16/12/86;	information from WNI
Z 32.6006	S 115.6267	E; see map;	17/04/85-24/04/87;	information from WNI
Z 32.6058	S 115.6219	E; see map;	17/04/85-16/09/85;	information from WNI
Z 32.8917	S 115.6750	E; see map;	12/12/83-29/03/85;	information from WNI
Z 32.8917	S 115.7397	E; see map;	04/10/85-27/05/86;	information from WNI
Z 34.3749	S 115.1546	E; see map;	15/06/87-15/06/87;	information from WNI
Z 34.3749	S 115.1546	E; see map;	15/07/87-15/08/87;	information from WNI

General locations are shown in Fig 6.1

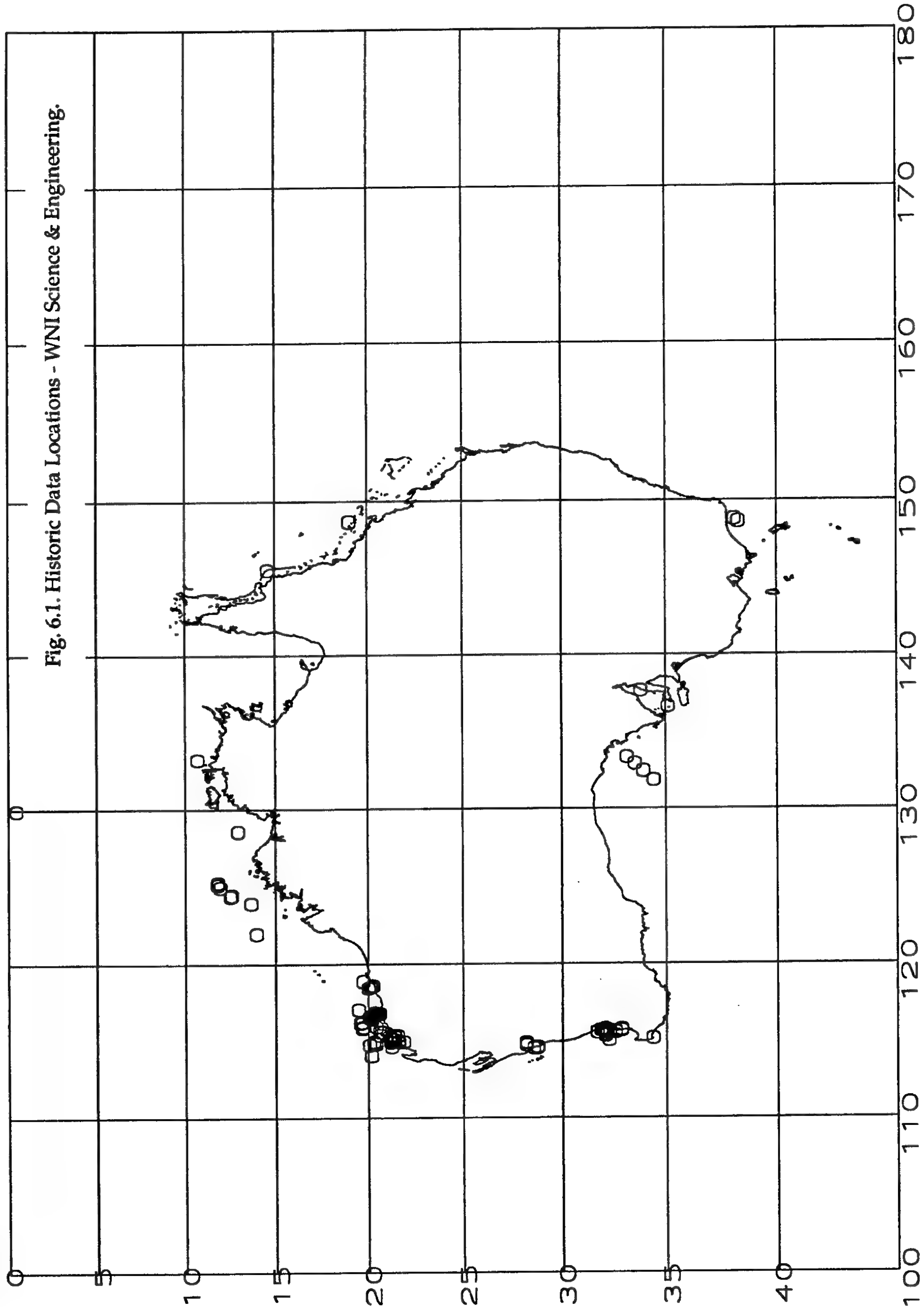

Fig. 6.1. Historic Data Locations - WNI Science & Engineering.

6.2 Lawson & Treloar Pty Ltd

SPECIAL LISTING - INFORMATION PROVIDED BY LAWSON & TRELOAR PTY LTD OF SYDNEY. ANY REQUESTS FOR INFORMATION ON THIS DATA SHOULD BE MADE DIRECTLY TO THE COMPANY.

(See following pages)

Lawson and Treloar Pty Ltd
Coastal, Ocean and Water Resources Consulting Engineers
Unit 24, Norberry Terrace
177-199 Pacific Highway, North Sydney 2060.
[PO Box 799, North Sydney NSW 2060]

Note that a listing in this document for data or reports does not necessarily mean that the data or reports are available for public use or perusal, or that data or reports are free of charge. Requests for data or information should not be made to DSTO, but directly to the organisations which gathered the data.

L&T WAVE DATA

LOCATION:	LAT / LONG	DEPTH:	START / END DATE:	INSTRUMENT:	COMMENT, QUALITY:
Burnie Tasmania	40°58'S 145°53'E	44m	11/83-9/85	Waverider	Good
Jervis Bay NSW					
Offshore	35°07'S 150°47'E	50m	11/82-2/90	Waverider	Good
Green Pt	35°01'S 150°45'E	14m	11/82-2/88	Waverider	Good
Honeymoon Bay	35°03'S 150°46'E	12m	11/82-2/86	Waverider	Good
Hyams Beach	35°07'S 150°42'E	13m	2/88-2/90	Waverider	Good
Darling Road	35°07'S 150°44'E	18m	2/86-2/88	Waverider	Good
Montagu Road	35°02'S 150°46'E	13m	2/88-2/90	Waverider	Good
North-East Channel Moreton Bay, Qld	26°58'S 153°21'E	20m	6/84-8/85	Sea Data 635-12 pressure recorder & XY currents	Good with wave direction
Jervis Bay, NSW Montagu Road	35°02'S 150°46'E	13m	3/83 - 3/84 6/84 - 9/84 7/87 - 10/87	Sea Data 635-11 pressure recorder	Good long wave data
Rosslyn Bay Qld	23°06'S 150°56'E	18m	2/87 - 4/87	Sea Data 635-12 pressure recorder & XY currents	Good with wave direction

LOCATION:	LAT / LONG	DEPTH:	START / END DATE:	INSTRUMENT:	COMMENT, QUALITY:
Port Stanvac SA					
Inshore 1	35°07'S 138°28'E	12m	6/88 - 10/88	Sea Data 635-12	Good
Inshore 2	35°07'S 138°28'E	12m	6/88 - 10/88	Waverider	Good
Offshore	35°06'S 138°26'E	22m	1/92 - 4/92	Waverider	Good
Providential Head NSW	34°08'S 151°09'E	35m	11/90 - 1/91	Sea Data 635-12	Good with wave direction
McGaurans Beach Vic	38°27'S 147°08'E	15m	6/91 - 11/91 3/93	Sea Data 635-12 Waverider	Good Good
Cape Cuvier WA	24°12'S 113°24'E	10m	7/88 (4days)	Sea Data 635-12	Good
Belmont NSW	33°03'S 151°41'E	19m	12/89 - 4/90 7/90 - 12/90	Sea Data 635-12 " "	Good Good
Pt Kembla NSW 3 sites in Outer Harbour	34°28'S 150°55'E	10m	9/92 - 1/93	Sea Data 635-11	Good long wave data
Pont Wilson, VIC					
West	38°07'S 144°28'E	5m	4/93 - 5/93	Sea Data 635-12	Good
Central	38°06'S 144°30'E	5m	4/94 - 11/94	Waverider	Good
East	38°06'S 144°32'E	9m	4/94 - 11/94	Waverider	Good

LOCATION:	LAT / LONG	DEPTH:	START / END DATE:	INSTRUMENT:	COMMENT, QUALITY:
Gulf of Carpentaria Qld	17°06'S 139°45'E	12m	7/91 - 7/92	Waverider	Good
Port Hedland WA					
No 1 buoy	20°00'S 118°26'E	21m	12/84 - 3/85	Sea Data 635-11	Good
No 3 buoy	20°05'S 118°25E	21m	2/84 - 4/84 & 12/84 - 3/85	.."	Good, including
No 5 buoy	20°10'S 118°30'E	16m	2/84 - 4/84	.."	Cyclone Chloe
Kingfish B Platform Bass Strait	38°36'S 148°11'E	78m	12/77 - present	Baylor wave Staff & Sea Data 624XP	Good with direction from 1989
Barracouta Platform Bass Strait	38°18'S 147°41'E	46m	12/77 - 5/87	Baylor wave staff	Good
Bougainville PNG Empress August Bay					
Inshore	06°24'S 155°30'E	5m	8/85 - 11/85	Sea Data 635-12	Good
Offshore	06°20'S 155°25'E	60m	6/85 - 1185	Waverider	Good
Kumul Platform Gulf of Papua	08°05'S 144°34'E	23m	6/92 - 8/92	Sea Data 635-12	Good with wave direction
Moreton Bay QLD	27°12'S 153°21'E	10m	10/80 - 10/84	Waverider	Good

7. PUBLISHED PAPERS AND REPORTS ON SEA AND SWELL AROUND AUSTRALIA

In general the publications listed are concerned with the existence or analysis of measured wave data, not with theoretical considerations. No claim to completeness is made for these listings. Publications on wave data are made by many different types of organisations for many different purposes e.g. contractors, shire councils, research laboratories and universities, and state and national bodies. The existence of some reports is not widely disseminated. Reports written by contractors for organisations such as harbour authorities, and oil and gas exploration companies, are often regarded as proprietary or commercial in confidence, and are not made available for general use. The bibliography should however be a representative sampling. Published **Coastal Engineering conference proceedings of the Institution Of Engineers Australia** (see appendix III for a listing) provided the initial bulk of the references.

Note that a listing in this document for data or reports does not necessarily mean that the data or reports are available for public use or perusal, or that data or reports are free of charge. Requests for data or information should not be made to DSTO, but directly to the organisations which gathered the data.

7.1 Bibliographies Examined

The following bibliographies and lists were examined for references on waves during the compilation of this general document.

Australian Marine Research In Progress (1985). Australian Institute of Marine Science. CSIRO Central Information, Library and Editorial Section. Great Barrier Reef Marine Park Authority. Victorian Institute of Marine Science. ISSN 0727-677X. [Produced from the information stored in the database AMRIP on CSIRONET]

Australian Oceanographic Data Centre (1995). Australian Research on the Physical Sciences of the Ocean 1991-1994. AODC Report 9/95. 67pp. [Submitted to International Association for the Physical Sciences of the Ocean at the XXI General Assembly of IUGG Hawaii, August 5-12 1995]

Beach Protection Authority Queensland (1989). 1989 Annual Report, 52pp. [Lists BPA publications available for purchase]

Beach Protection Authority Queensland (1995). Saleable Publications List (1995). Department of Environment and Heritage.

Black K.P. and Mourtikas S. (1992). Literature review of the physics of Port Phillip Bay. CSIRO Port Phillip Bay Environmental Study. Technical Report No. 3.

Bureau Of Meteorology (1993). Catalogue Of Publications.

Centre for Water Research. Water Research 1989-1990. Research Report. University of Western Australia. 101pp.

Harris P.T., Baker E.K. and Cole A.R. (1991). Physical sedimentology of the Australian continental shelf. Ocean Sciences Institute Report No. 51. The University of Sydney. 505pp. [Contains brief discussions of, and several references to, waves near major ports around Australia]

Institution Of Engineers Australia (1973). Coastal and Ocean Engineering in Australia. A survey by the National Committee on Coastal and Ocean Engineering of The Institution of Engineers, Australia. [Lists organisations gathering, predicting, or modelling wave data, and wave study sites in Australia and Papua New Guinea, but no data details]

Pearce A.F. (1983). A bibliography of Physical Oceanography in southwest Australian waters. CSIRO Marine Laboratories Report 157. 36pp. [Cape Leeuwin to Northwest Cape. Circulation, temperature, salinity, waves, tides, sea level, and meteorology]

Prescott J.R.V. (editor) **(1979).** Australia's Continental Shelf. The Australian Institute Of International Affairs. Nelson (Thomas Nelson Australia Pty Ltd, Victoria). [Appendix II by D.F. Prescott is "Guide to maps of the Australian continental shelf", which lists some references to wave refraction diagrammes]

Public Works Dept (1986-1995). New South Wales wave climate, annual summary 19xx/xx. Public Works Department NSW Manly Hydraulics Laboratory Reports. [Have bibliographic sections e.g. 1986/87 has "Publications of Interest". Part 1 is 'Wave Data Collection and Analysis - General'. Part 2 is 'Wave Data Collection and Analysis - New South Wales'. Part 3 is 'New South Wales Wave Climate Annual Summaries']

Public Works Dept (1992). New South Wales Wave Climate Program. Published conference papers. Public Works Department NSW Manly Hydraulics Laboratory, October 1992. [Has a bibliographic section "6. New South Wales Wave Climate Program Report Bibliography"] [See PWD (1995) for a later edition] [See 7.4.3 of this document]

Public Works Dept (1992). Projects And Publications. Manly Hydraulics Laboratory Document No. SP-MHL-004. 57pp.

Public Works Dept (1995). New South Wales Wave Climate Program. Published conference papers and report bibliography. November 1995. [The report bibliography is reproduced directly in the present compilation, courtesy of Mark Kulmar]

Water Research Laboratory (1988). Research and Technical Report List. The University of New South Wales Water Research Laboratory. Manly Vale. January 1988. 54pp.

7.2 Wave Atlases and Inventories

Wave atlases compiled from ship observations have been published in chart form for many years, and more recently are available on CD-ROM. The data are generally given as broad spatial averages, showing average wave heights and periods, and also frequency histogrammes of heights and periods with direction. ***The Marine Information and Advisory Service of the United Kingdom published a waves catalogue in 1979 under the title "Instrumentally Measured Wave Data. Issue 1", which included Australian sites.*** A revised edition was published in 1982. For further details see Draper (1980) or "Engineering Offshore. Engineering Implications of an Australian 200 mile exclusive economic zone", The Institution Of Engineers, Australia. ***The MIAS catalogues form the only known public national inventory of Australian wave data.*** These records are presently being moved to ORACLE database form (Neave, personal communication).

Anon (1994). Integrated Global Ocean Services System Products Bulletin. October-December 1994. Intergovernmental Oceanographic Commission (of UNESCO) and World meteorological Organization. 30pp. [Issued quarterly. Has charts of <Monthly mean significant wave height hindcast from the "Global Wave Model"> produced by the United Kingdom] [Possibly available on the World Wide Web at http://rainbow.ldeo.columbia.edu/. LDEO home page]

British Meteorological Office (1965). Wave states for the world.

Hogben N., Dacunha N.M.C. and Olliver G.F. (1986). Global Wave Statistics. British Maritime Technology Limited, Middlesex.

Hogben N. and Lumb F.E. (1967). Ocean Wave Statistics. Ministry Of Technology, National Physics Laboratory. London: HM Stationery Office.

Koninglijk Nederlands Meteorologisch Institut (KNMI) (1949). Seas around Australia - oceanographic and meteorological data. Netherlands Meteorological Institute Publication No. 124.

Marine Information And Advisory Service Of The United Kingdom (1979). Instrumentally Measured Wave Data. Issue 1. ["A data base is being built up of measured wave parameters from a number of stations for the Australian coast. An index to most of these sites is published by the Marine Information and Advisory Service of the United Kingdom under the title of "Instrumentally Measured Wave Data". Issue 1 was published in 1979." - Engineering Offshore. Engineering Implications of an Australian 200 mile exclusive economic zone. The Institution Of Engineers, Australia] [Draper (1980) shows two examples for Coffs Harbour]

MIAS CATALOGUE OF INSTRUMENTALLY-MEASURED WAVE DATA (1982). MIAS Reference Publication No. 1, second edition, March 1982. Marine

Information and Advisory Service (MIAS), Institute of Oceanographic Sciences, Wormley, Godalming, Surrey GU8 5UB, U.K. [Now in ORACLE database form]

McMillan J.D. (1981). A global atlas of GEOS-3 significant waveheight data and comparison of the data with national buoy data. NASA Contractor Report 156882 (NASA-CR-156882). National Aeronautics and Space Administration. [Contains many references to GEOS-3 and Seasat altimeter wave data] [Charts of Hsig]

Monthly Meteorological Charts (1949). Indian Ocean. Meteorological Office, Great Britain.

Monthly Meteorological Charts (1956). Western Pacific Ocean. Meteorological Office, Great Britain. [Monthly swell roses in quadrants for slight, moderate, and heavy swell. Frequency of no swell and of confused swell. For 5x5 degree areas]

U.S. Naval Oceanographic Office, Washington (1949). Atlas of sea and swell charts. Indian Ocean.

U.S. Navy (1974). U.S. Navy Marine Climatic Atlas of the World. Vol I. NAVAIR 50-1C-528. U.S. Govt. Printing Office, Washington, D.C. 20402.

U.S. Navy (1976). U.S. Navy Marine Climatic Atlas of the World. Vol III, Indian Ocean. U.S. Navy, NAVAIR 50-1C-530. U.S. Govt. Printing Office, Washington, D.C. 20402.

U.S. Navy (1979). U.S. Navy Marine Climatic Atlas of the World. Vol V. South Pacific Ocean. U.S. Navy, NAVAIR 50-1C-532. U.S. Govt. Printing Office, Washington, D.C. 20402.

U.S. Navy (1969). U.S. Navy Marine Climatic Atlas of the World. Vol VIII. The World. U.S. Navy, NAVAIR 50-1C-54. U.S. Govt. Printing Office, Washington, D.C. 20402.

U.S. Navy (1981). U.S. Navy Marine Climatic Atlas of the World. Vol IX. World-wide means and standard deviations. U.S. Navy, NAVAIR 50-1C-65. U.S. Govt. Printing Office, Washington, D.C. 20402.

U.S. Navy Hydrographic Office (1943). Atlas of sea and swell charts for north-west and south-west Pacific Ocean. Publication No. 799 CE.

U.S.S.R. Ministry Of Defence (1974). Atlas of the Pacific Ocean.

7.3 CD-Roms

U.S. Navy Marine Climatic Atlas of the World. National Climatic Data Centre, 151 Patton Avenue, Room 120, Federal Building, Asheville, NC 28801-5001. Internet: orders@ncdc.noaa.gov. {This centre also has a database of worldwide ship and buoy observations (hourly/synoptic) - from 1800s to present}. U.S. Dept of Commerce, National Oceanic and Atmospheric Administration.

U.S. Navy Geosat Wind/Wave data from the geodetic mission: March 31 1986 to Sept 30 1986. National Oceanographic Data Centre, User Services Branch, NOAA/NESDIS E/OC21, Washington DC 20235. {Non-U.S. citizens must submit all orders for Geosat data to the NODC through the science officer of their country's embassy in the United States}

Young I.R. and Holland G.J. (1996). Atlas of the oceans: Wind and Wave Climate. CD-ROM Version 1.0. Elsevier Science Limited. Available from Elsevier Science B.V., P.O. Box 211, 1000 AE Amsterdam, The Netherlands. Details also at WWW.http://www.elsevier.nl. [Numerical source data: GEOSAT/NASA]

OCEANOR has launched a PC MS-Windows© product called **World Wave Atlas** version 1.0 (1995). Satellite Application Group, OCEANOR, Pir-Senteret, N-7005 Trondheim, Norway. [Presents calibrated, quality controlled GEOSAT altimeter data including wave statistics and extreme value analysis for any area globally. (Quote from "Wave-Climate Assessment By Satellite Remote Sensing" by Dr. Stephen F. Barstow and Dr. Harald E. Krogstad in Sea Technology, October 1995, Volume 36, No. 10, pp31-38). A demonstration may be found on the Internet at http://www.oceanor.no/wwa/wwa. Topex/Poseidon and ERS data may also be included]

7.4 Papers And Reports

A number of references in the following bibliography contain only a passing mention of wave conditions. At the commencement of the bibliography the amount of information for particular areas was unknown, and it was decided to reference all information, no matter how slight, and regardless of whether the observation time was short or long term. Some references therefore act as pointers to data or information held by particular researchers or institutions, rather than having detailed information themselves.

Note that a listing in this document for data or reports does not necessarily mean that the data or reports are available for public use or perusal, or that data or reports are free of charge. Requests for data or information should not be made to DSTO, but directly to the organisations which gathered the data.

7.4.1 Australia and New Guinea (for Torres Strait see Queensland)

Anderson S.J. (1977). Over-the-horizon radar meteorology. Tech Report 1752(A), Weapons Research Establishment, Dept Of Defence, 16pp. [Jindalee skywave radar]

Anderson S.J. (1986). Remote sensing with the JINDALEE skywave radar. IEEE Journal of Oceanic Engineering, Vol OE-11, No. 2, 158-163. [Capability to measure sea state, wind fields, currents; linked to BOM]

Anderson S.J. (1990). Skywave radar oceanography. Proceedings of the Fifth Australasian Remote Sensing Conference Perth, Western Australia 8th-12th October 1990. pp772-776. [Jindalee, JORN]

Anderson S.J. (1990). HF Skywave radar measurements of cyclone-generated ocean waves. Proc. Radarcon-90, 315-323.

Aquilina M. (1982?). Sea and swell: Australian waters. Australian Oceanographic Data Centre. 146pp. [Sea and swell roses. Percent < 4 feet February, May, August, November. Percent > 20 feet February, August. Quarterly wind and swell wave height percentages for areas around Australia and New Guinea]

Australian Maritime College (1989). Collected papers from the A.M.C/A.S.I. project on the hydrodynamic performance of Australian trawlers. School Of Nautical Studies A.M.C. [ASI = Australian Shipbuilding Industries. Model tests on trawlers]

Black K.P., Brand G.W., Grynberg H., Gwyther D., Hammond L.S., Mourtikas S., Richardson B.J. and Wardrop J.A. (1994). Environmental Implications of Offshore Oil and Gas Development in Australia - Production Activities. Part 4 of The findings of an independent scientific review on behalf of the Australian Petroleum Exploration Association (APEA) Energy Research and Development Corporation (ERDC). Victorian Institute of Marine Sciences, East Melbourne, Victoria, 209-407. [Brief discussions of waves for Bass Strait and North West Shelf]

British Hovercraft Corporation (1968). A study of wind and sea conditions along the coasts of New Guinea. PUB-SP-2044. 01-July-1968. 20pp. [Climate, wind and sea conditions that may be expected along the coasts of New Guinea]

Bureau Of Meteorology (1973). Report of seminar. [Conference name: Measurement and application of sea state data seminar 1973 Melbourne. Also see Morgan (1973)]

Cotton P.D. and Carter J.T. (1994). Interannual variability in global wave climate from satellite data. In Proceedings Europt Series. Oceanic Remote Sensing and Sea Ice Monitoring. 26 Sept 1994, Rome, Italy. SPIE volume 2319, pp174-180. [Altimetry from Geosat, ERS-1, Topex/Poseidon 1986-1994. Possible link to El Nino-Southern Oscillation Index]

Dexter P.E. (1982). Radio oceanography: the determination of sea surface wind and wave parameters with an HF radar. Bureau Of Meteorology Meteorological Study No. 31. [Thesis (Ph. D), James Cook University of North Queensland.]

Draper L. (1980). Sources of measured wave data. 17th International Conference on Coastal Engineering, Sydney, 23-28 March 1980. The Institution of Engineers, Australia. National Conference Publication No. 80/1. [Discusses a Responsible National Data Centre for Waves (RNODC(W)), with a world-wide network of Area Representatives]

Earl G.F. and Ward B.D. (1986). Frequency management support for remote sea-state sensing using the JINDALEE skywave radar. IEEE Transactions on Oceanic Engineering, 164-173.

Evans (1963). Wave disturbance models. In Engineers 6th biennial conference report, 1963, Melbourne, Victoria. Australian Port Authorities Association. 400pp. [Unexamined]

Gaffney D.O., Trajer F.L. and Dexter P.E. (1979). Meteorological aspects of the 200 mile economic zone in the Australian region. In Australian Symposium On Ship Technology. The impact of 200 mile economic zones. At University of New South Wales, 5-7 November 1979. pp13-31. [Describes BOM services e.g. gale warnings]

Heathcote K.A. (1978). Prelude to AS '1980' - wave loading code. Fourth Australian conference on coastal and ocean engineering. Adelaide, 8-10 November 1978. The Institution of Engineers Australia National Conference Publication No. 78/11, 228-230. (Barton A.C.T.) [Suggested defining design waves for nine wave loading zones around Australia]

King G.W. (1982). RAN Patrol Boat Force Study - sea conditions around Australia and Papua New Guinea. Central Studies Establishment, Working Paper PBF-2.

Laughlin G.P. (1990). The complete book of Australian maritime weather. W. Gibson Group, Brookvale N.S.W. 79pp. (ed W. Gibson) [Wind, waves, and swell. Boat handling under adverse conditions. Fold-out wind maps of Australia]

Morgan G.A. (1972). Sea-state statistics for the Australian region. Weapons Research Establishment Technical Note 764 (WRE-TN-764 (WR&D)). Salisbury, South Australia. [Statistics based on wind speeds at coastal locations of Australia and New Guinea]
||
Morgan G.A. (1973). Sea-state statistics for the Australian region. In *Report Of Seminar On The Measurement And Application Of Sea State Data.* Bureau Of Meteorology. June 1973. 9pp, 182 figs.

Phillips D.M. (1976). Wind, sea and swell around the Australian coast. Weapons Research Establishment (Australia) Technical Note WRE-TN-1628. [Data from several sources + discussion of water surface conditions likely to be encountered for Australian coastal waters]

Quayle R.G. and Changery M.J. (1982). Estimates of coastal deep water wave energy potential for the world. National Climatic Centre, Asheville, NC 28801, USA, pp903-907.

Radok R. (1968). Ocean waves and coastal operations. Horace Lamb Centre for Oceanographical Research Survey Paper 7. [Content unknown]

Schaetzel S.S. (1979). Latitude effects on world sea states. Hawker de Havilland Australia Pty Ltd Report/Des/15. September 1979. [Attempts to derive general relations concerning the prevalent sea states in the Pacific by latitude]
||
Schaetzel S.S. (1979). Latitude effects on world sea states. In Australian Symposium On Ship Technology. The impact of 200 mile economic zones. At University of New South Wales, 5-7 November 1979, pp199-215. [The foreword states: This paper is an abbreviation of the first half of Hawker de Havilland Report/Des/15 to be issued in August 1979. The second half, including the discussion of the Department of Defence (DOD) figures of Australian Sea States is not included, due to lack of space. (This presumably refers to Morgan 1973)]

Silvester R. and Mitchell L. (1977). Ocean waves around the coastlines of Australia. 6th Australasian Hydraulics and Fluid Mechanics Conference, Adelaide, 5-9 December. 160-164. [Table of maximum storm surge for 35 regions round Australia]

Stone D.M. (1969). A wave recording network for Australia. Working Paper No. 121, Bureau Of Meteorology. [H1.121 Proposed a network of 20 buoys around Australia]
||
Stone D.M. (1969). A wave recording network for Australia. Water Research Laboratory Report 115. University of New South Wales. April 1969. [Same as H1.121 above]

Trajer F.L. (1975). Surface wind statistics for planning offshore operations. Second Australian Conference on Coastal and Ocean Engineering, Gold Coast, 85-87. ["In sheltered waters a technique proposed by Trajer will estimate the sea climatology"]

Truelove D.J. (1986). Seastates In waters Near Australia. Directorate Of Forward Design (Ship Projects). Naval Engineering Division DFD(SP) Technical Memorandum No. 1/86. Navy Office, Canberra. [Annual and monthly probabilities of significant waveheight being less than a nominated value in waters around Australia. Based on USN Marine Climatic Atlas Vol. 3 1979; and Department of Transport and Construction (1982) - Wave

climate at proposed explosives wharf sites, Jervis Bay. Report No. MW118, Maritime Works Branch, November 1982 (data off Botany Bay)]

Young I.R. (1994). Global ocean wave statistics from satellite observations. Applied Ocean Research 16(4), 235-248. [GEOSAT mean monthly wave height statistics (exceedances) for the world]

On the internet at **http://www.ozemail.com.au/~michaelt/asurf.htm** may be found a four page description of general surfing conditions "Surfable Areas Of Australia" under the web name "Surfing Maps Of Australia".

7.4.2 Queensland (including Torres Strait)

SPECIAL BIBLIOGRAPHIC LISTING FOR THE BEACH PROTECTION AUTHORITY OF QUEENSLAND

(a) PUBLICATIONS FOR SALE from 1989 ANNUAL REPORT;

(b) BPA SALEABLE PUBLICATIONS LIST (1995).

Note: some duplication occurs in the 1989 and 1995 listings.

(See following pages)

Publications for Sale

Report	Price
(a) Coastal Investigation Reports	
Delft Report R257 — Gold Coast (1970)	$50
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Lammermoor Beach — Livingstone Shire	
Noah Creek — Douglas Shire	
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Mission Beach — Johnstone Shire	
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Shingly Beach — Proserpine Shire	
Yeppoon — Livingstone Shire	
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Barwell Creek — Livingstone Shire	
Currigee — City of Gold Coast	
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Cairns (1986)	
Mackay (1986)	
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Townsville (1988)	

Report	Price
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Numerical Simulation of Tropical Cyclone	$25 each site
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Cairns	
Innisfail	
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Gold Coast	
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Townsville	
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(g) Other Publications	
Nerang River Entrance Stabilization Model Investigations. Nerang River Entrance Stabilization. M1259. Delft Hydraulics Laboratory (1976)	$30
Nerang River Entrance Breakwater Stability Model Report	$25
Green Island Data Report	$100

Notes:

(1) Copies of the above reports published by the Beach Protection Authority are available

(2) In addition to these saleable publications, the Authority also has produced a number of brochures, posters, newsletters leaflets, which are available free of charge on request.

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WAVES AND SWELL - QUEENSLAND

COPE (Coastal Observation Programme Engineering) Visual Observations Reports - Beach Protection Authority

Note: See the foregoing special bibliographic listing of Beach Protection Authority publications for a full listing of COPE reports.

Beach Protection Authority Queensland (1980). Coastal Observation Programme Engineering (COPE) - Flying Fish Point - Johnstone Shire. Report No. C03.1, 35pp.

Beach Protection Authority Queensland (1990). COPE - Coastal Observation Programme - Engineering. Beach Protection Authority of Queensland newsletter. Beach Conservation No. 69.

Department of Environment and Heritage (1995). Coastal Observation Programme Engineering (COPE) North Kirra, City of Gold Coast - 1988-1993. Conservation Report No. C31.1.

Department of Environment and Heritage (1995). Coastal Observation Programme Engineering (COPE) Bilinga, City of Gold Coast - 1990-1995. Conservation Report No. C32.1

Department of Environment and Heritage (1995). Coastal Observation Programme Engineering (COPE) Currigee, City of Gold Coast - 1972-1995. Conservation Report No. C33.2.

GENERAL PUBLICATIONS

Note: See the foregoing special bibliographic listing of Beach Protection Authority publications for a full listing of BPA reports.

Allen and Ettema (1993). Implementation of a new wave recording system. Eleventh Australasian Conference on Coastal and Ocean Engineering. 23-27 August 1993, Townsville. N.C.P. 93/4, 719-.

Anderson L.J. and Grainger B.B. (1977). Tug harbour - Hay Point. 3rd Australasian Conference on Coastal and Ocean Engineering. Melbourne, 21-25. [Prediction of cyclone wave heights]

Andrews M.J., Zwar M.K. and Irwin C.N. (1995). Monitoring of the southern Gold Coast beach nourishing project - 1995 update report. 12th Australasian coastal and ocean engineering conference. Melbourne, 28May-02June, Institution of Engineers, Australia, pp 1-6.

Anon (1956). Proceedings of the Tropical Cyclone Symposium. Brisbane, 1956. [Quoted in BOM (1966)]

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Anon (1994). Annual Report 1993-94. Queensland Department of Environment and Heritage. 108pp. [Brief mentions of waverider sites]

Australian Institute Of Marine Science Annual Report 1991-92. [Lists Program 4.10 as 'Interactions of surface waves and reef structures', 'Statistical and spectral characteristics of wind-induced waves in the deep sea and Great Barrier Reef Lagoon', and 'Wave dynamics in shoaling waters', carried out by S. Massel]

Australia Pilot (1992). Volume III. East coast of Australia from Outer North Head to Cape York, including the Great Barrier reefs, islands and reefs of the Coral Sea, Torres Strait, and the south coasts of Papua and Irian Barat between Parama Island and the meridian of 140°40'E. Admiralty Charts And Publications N.P. 15. Hydrographer Of the Navy. Taunton, Somerset, England. [General descriptions of sea conditions]

Beach Protection Authority Queensland (1978). Wave data recording programme - Cairns. Technical Memorandum No. W01.1. (For 02May1975 - 03Sep1978, 18m, 16°41'35"S, 145°42'30"). [Maximum Hsig 1.91 m. Typically Hsig 0.5 m, peak period 4 s]

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Beach Protection Authority Queensland (1979). Wave data recording programme, Townsville region. Technical Memorandum No. W03.1. (Data for 16Jul75 - 23Feb79)

Beach Protection Authority Queensland (1982). Wave data recording programme, Sunshine Coast region. Technical Memorandum No. W04.1. (For 05Apr74 - 05July77)

Beach Protection Authority Queensland (1983). Wave data recording programme, Burnett Heads region. Technical Memorandum No. W05.1. (For 05May76 - 05Mar82)

Beach Protection Authority Queensland (1983). Wave data recording programme, Abbot Point region. Technical Memorandum No. W06.1. (For 06May77 - 08Aug79)

Beach Protection Authority Queensland (1983). Wave data recording programme, Weipa region. Technical Memorandum No. W07.1. (For 21Dec78 - 07Apr83, depth 7m, 12°41'S, 141°45'E). [Outside of cyclone season Hsig < 0.3 m, peak period 2 s. Maximum Hsig 3.09 m]

Beach Protection Authority Queensland (1984). Mulgrave Shire Northern Beaches. Coastal Investigation Report. (Data for Cairns 19Mar81 - 12July82)

Beach Protection Authority Queensland (1984). Wave data recording programme, Gladstone region. Technical Memorandum No. W08.1. (For 19Dec79 - 16May83)

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Beach Protection Authority Queensland (1986). Wave data recording programme, Mackay region. Technical Memorandum No. W02.2. (For 17Sep75 - 05Nov76, 24Nov77 - 23Aug85)

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Beach Protection Authority Queensland (1989). Wave data recording programme, Burnett Heads region. Technical Memorandum No. W05.2. (05May76-13Oct88)

Beach Protection Authority Queensland (1989). Wave data recording programme, Bramston Beach region. Technical Memorandum No. W12.1. (16Dec81-28Oct85)

Beach Protection Authority Queensland (1989). 1989 Annual Report, 52pp. [Shows charts of waverider and visual observation sites]

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Beach Protection Authority Queensland (199-). Wave data recording programme, Brisbane region 1976-94. Technical Memorandum No. W09.2. (31Oct76-30Jun94)

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Beach Protection Authority Queensland (199-). Wave data recording programme, Kirra region 1988-94. Technical Memorandum W15.1. (25Aug88-30Jun94)

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December 1989, Adelaide, pp73-77. [Heron Island. Average wave-heights were less than 0.8 m]

Gourlay M.R. and Hacker J.L.F. (1991). Raine Island - coastal processes and sedimentology. Univ. Qld. Dept. Civ. Engng Report CH40/91. [Waves breaking on Raine Island beaches were limited in height by water depth over the reef flat offshore of the observation site]

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[Wave refraction diagramme for the area north of Bribie Island to Double Island Point for wave period of 12 seconds]. [Nerang River to Cape Moreton: wave refraction diagramme showing approach of southeast swell for wave period of 14 seconds]

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NEW SOUTH WALES WAVE CLIMATE PROGRAM

This particular bibliography is for the New South Wales Wave Climate Program conducted by the Manly Hydraulics Laboratory (NSW Public Works and Services Department). It was provided by Mark Kulmar of Manly Hydraulics Laboratory. The listings are a subset of the Manly Hydraulics Laboratory reports. Some of the references are also listed in the following section WAVES AND SWELL.

The following tables list all reports which include information on the New South Wales Wave Climate Program, associated instrumentation, computer hardware and software, data presentation, wave studies and annual data summaries. The reports were prepared at Manly Hydraulics Laboratory by the Department of Public Works and Services and for Australian Water and Coastal Studies Pty Ltd.

NSW Wave Climate: Manly Hydraulics Laboratory Reports

Report	Title	Date
MHL218	Waverider Operations Manual	Nov 1977
MHL300	Waverider System Software - The Raw Data Archiving System	Sep 1980
MHL310	Wave Data Analysis Suite	Oct 1980
MHL311	Wave Data Collection Systems at Manly Laboratory	Apr 1982
MHL338	Specification for Wave Data System	Aug 1983
MHL394	Waverider User's Manual	May 1984
MHL394	Waverider User's Manual, Revised Edition	Sep 1986
	Waverider User's Manual, Version 3.4	Jun 1993
MHL399	DWAVE - Wave Data Software	Jul 1987
MHL406	Zwarts User's Manual	May 1984
MHL406	Zwarts User's Manual, Revised Edition	Jul 1987
MHL416	Wave Statistics for Port Kembla	Aug 1984
MHL422	Comparison of Wave Statistics between Byron Bay and Coffs Harbour	Nov 1984
MHL427	DWAVE Data Presentation	Jan 1985
MHL427	DWAVE Data Presentation, 2nd Edition	Sep 1985
MHL436	Wave Data Conditioning	Aug 1985
MHL442	Hand Reduction of Wave Data for Port Kembla 1974 - 1983	Nov 1985

MHL456	Development of a Radar Facility to Measure Wave Direction and Currents	Apr 1986
MHL476	Jervis Bay Wave and Tide Data	Jun 1988
MHL542	Eden Wave Data Collection Network	Nov 1988
MHL543	Nelson Bay Wave Data	Jul 1988
MHL556	Batemans Bay Oceanographic and Meteorological Data 1986 - 89	Aug 1990
MHL591	Storm Surges Monitored along the N.S.W. Coast - April 1990	Nov 1991
MHL656	Sydney Directional Waverider Buoy Interim Report	Apr 1995

NSW Wave Climate: Annual Wave Data Summaries

Report	Title	Date
MHL465	New South Wales Wave Climate Annual Summary 1985/86	Sep 1986
MHL520	New South Wales Wave Climate Annual Summary 1986/87	Oct 1987
MHL547	New South Wales Wave Climate Annual Summary 1987/88	Oct 1988
MHL560	New South Wales Wave Climate Annual Summary 1988/89	Nov 1989
MHL581	New South Wales Wave Climate Annual Summary 1989/90	Oct 1990
MHL600	New South Wales Wave Climate Annual Summary 1990/91	Sep 1991
MHL627	New South Wales Wave Climate Annual Summary 1991/92	Oct 1992
MHL655	New South Wales Wave Climate Annual Summary 1992/93	Sep 1993
MHL695	New South Wales Wave Climate Annual Summary 1993/94	Oct 1994
MHL733	New South Wales Wave Climate Annual Summary 1994/95	Oct 1995

NSW Wave Climate: Australian Water and Coastal Studies Reports

Report	Title	Date
90/07	DWAVE - Wave Data Software Wave Power Statistics User's Guide	Jul 1990
91/08	Wave Power Study for Selected Sites along the N.S.W. Coastline	May 1991

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7.4.5 Tasmania (for Bass Strait see Victoria)

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7.4.6 *South Australia and Southern Ocean*

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7.4.7 South-Western Australia (Wilson Bluff (Eucla) to North West Cape)

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7.4.8 North Western Australia (including North West Shelf and Timor Sea)

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Buchan S.J. (1985). Applications of a shallow water directional wave recorder. *7th Australasian Conference on Coastal and Ocean Engineering,* Christchurch, New Zealand. (2)107-114. [Directional wave recorder near Barrow Island during cyclone Chloe February 1984. In Mermaid Sound the predominant windwaves come from north-north-east, and swell is refracted to come from a north-north-westerly direction; bimodal wave climate. Cape Peron]

Buchan S.J. and Russell K.L. (1987). Applications of measured wave kinematics. 8th Australasian Conference on Coastal and Ocean Engineering, Launceston, Tasmania, 58-62. [Mentions wave data for Mermaid Sound near Dampier, Dawesville near Mandurah, and Streaky Bay in South Australia]

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7.4.9 North Australia in general

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7.4.10 Northern Territory

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Jim Waldron of the Queensland Beach Protection Authority provided details of waverider deployments and BPA activities.

Dr David Walker of Dept Of Engineering, University of South Australia provided a voluminous wave atlas for South Australian waters.

Andrew Walsh of the Australian Oceanographic Data Centre located a copy of the MIAS catalogue (1982) and details of PWD deployments for W.A.

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APPENDIX I. CROSS-REFERENCES.

Appendix I.A Locations And Papers

Data or reports are available for the sites listed in this rudimentary appendix. Names in **bold type** have real-time instrumented systems, and names in ***bold italics*** are scheduled to have real-time instrumented systems e.g Jabiru. Not all WNI sites from section 6.1 are listed (see Fig 6.1). Lighthouses of section 5.1.3 are included. Locations for storm surge papers of Appendix I.C are omitted.

* = multiple references by the same author(s).
BBW = Blain, Bremner & Williams
BOM = Bureau Of Meteorology
BPA = Beach Protection Authority of Queensland report
C&W = Culver & Walker
COPE (Coastal Observation Programme - Engineering) (see 4.2 for details)
DH&M = Dept of Harbours & Marine
DMH = Dept of Marine & Harbours
IOE = Institution of Engineers Australia. Lists sites but no details.
L&T = Lawson & Treloar
MHL = Manly Hydraulics Laboratory
MSB = Maritime Services Board
MWB = Maritime Works Branch
PPB = Port Phillip Bay
PWD = Public Works Dept
RKS&A = R.K. Steedman & Associates
VIMS = Victorian Institute of Marine Science
WRL = Water Research Laboratory

PAPUA NEW GUINEA (British Hovercraft Corp 68; King 82, Morgan 72)

Empress August Bay (Bougainville)
Kerema (Purari River). Purari River WABO Power Project (1977).
Kieta. IOE 73 [mentions studies of wave conditions and ship motions at wharf]
Kumul Platform (Gulf of Papua)
Wewak. IOE 73 [mentions predictions by BOM]

AUSTRALIA IN GENERAL

Aquilina 82; Australia Pilots; MIAS 79, 82; Morgan 72; Phillips 76; Silvester & Mitchell 77; Truelove 86; Young 94
(See sections 7.2 and 7.3 for wave atlases and inventories e.g. for Indian Ocean, North-west Pacific, South Pacific, South-west Pacific, Western Pacific Oceans. For Southern Ocean see section 7.4.6 South Australia)

NORTH AUSTRALIA IN GENERAL (see 7.4.9)

NORTHERN TERRITORY

Bathurst Island.
Cape Don.
Darwin (see East Arm, Larrakeyah). AWACS; Byrne 87; L&T 84; Scott 85; VIPAC 94.
East Arm (Darwin). AIEDA prototype buoy June 96.
Elcho Island.
Gove (Rocky Point). BOM 66.
Gulf of Carpentaria (see Queensland)
Gulf of Carpentaria (Roper River). Kenyon & Poiner 87
Larrakeyah (Darwin Harbour). Byrne 87; Scott 85
Minjilang.
Rocky Point (see Gove)

QUEENSLAND (Gardiner 75)

Abbot Point. BPA 83.
Agincourt Reef No. 3.
Albatross Bay (Weipa area). Meynink 73.
AIMS harbour (Australian Institute of Marine Science. Cape Ferguson). Nittim & Pite 75.
Ashmore Reef
Baffle Creek - Miriam Vale Shire. BPA - COPE.
Bargara. BPA - COPE
Barwell Creek. BPA - COPE
Bilinga (Gold Coast). BPA - COPE
Blacks Beach, Pioneer. COPE
Bowen. BPA 85.
Bramston Beach (Cairns). BPA - COPE 89*.
Bramston North (Cairns). BPA - COPE.
Breaksea Spit. IOE 73
Bribie Island. Hails 64.
Brisbane (International Airport). Crabb & Wilkinson 81.
Brisbane (Moreton Bay)
Brisbane (Point Lookout). BPA 85, 9-.
Buddina Beach. BPA - COPE.
Bundaberg
Burleigh Heads. BPA - COPE.
Burnett Heads. BPA 83, 89.
Burnett River. BPA.
Burrum. BPA.
Bushy Island
Cairns. BPA 74, 84, 86, 89; Murray & Ford 83.
Caloundra (see Moffat Beach)
Cape Byron. Delft 70.
Cape Cleveland (see Townsville)
Cape Ferguson (see AIMS).
Cape Flattery. IOE 73
Cape Moreton. Delft 70.
Capricornia Region. BPA 79; Gourlay & McMonagle 89; Hails 64; Patterson & Ford 80
Cardwell. BPA - COPE
Carpentaria Shoal. Miller & Foster 77
Cleveland Bay (also see Townsville). Blain et al 78, 84; Carter & Johnson 87; Carter et al 93; Larcombe et al 95; McIntyre & Assctes 74; Pringle 89; Riedel & Service 85; Sobey et al 78; Sobey & Rossow 77;
Clifton Beach, Mulgrave. COPE. Patterson & Blair 83.
Cloherty's Peninsula, Brisbane. COPE
Coolangatta Beach. COPE
Coolum Beach. COPE
Coonarr
Cowley Beach. COPE
Currigee, Gold Coast. BPA - COPE. Patterson & Blair 83
Danger Point
Double Island Point. Hails 64
Dundubara, Hervey Bay. COPE
East Farnborough, Livingstone. COPE
East Queens Beach, Bowen. COPE
Elliott River. BPA
Etty Bay, Johnstone. COPE
Eurong Beach - Maryborough. BPA - COPE
Fitzroy Island.
Forrest Beach, Hinchinbrook. COPE
Flying Fish Point. BPA - COPE
Gladstone. BPA 84.
Gold Coast. BPA 9-; Delft 70

Gold Coast (Kirra). Chapman 78; Chapman & Smith 83; McGrath & Patterson 72, 73; Pattearson and Patterson 83; Smith 73
Gold Coast (southern). Andrews et al 95; Murray et al 93
Gold Coast (The Spit)
Great Barrier Reef. Done 82; Hardy 93; Hardy & Young 91; Hardy et al 90*; Lee & Black 79; Massel 92, 94*; Massel & Done 93; Nelson 93; Nelson & Lesleighter 85, 86; Sobey 78; Stark 78; Wolanski 85; Young 89; Young & Hardy 93
Green Island. BPA 89; Trindade & Scott 91
Gulf of Carpentaria (see BOM 66; Whittingham 67; Carpentaria Shoal; Karumba; Sweers Island; Weipa)
Half Tide Harbour (also see Hay Point). Blain et al 84
Harbour Beach, Pioneer. COPE
Hayman Island. Gourlay 72
Hay Point. Anderson & Grainger 77; BPA 90; Blain et al 84; Bremner & Foster 87; Britton & Macknight 75
Heron Island. Gourlay 91.
Hervey Bay. BPA 89; Carter & Patterson 87; Patterson & Carter 87
Holloways Beach (Cairns)
Hull Heads - Cardwell. BPA - COPE
Hydrographer's Passage. Snowy Mountains Engineering Corporation 1984 - flume studies
Jessica Point, Weipa. Dudgeon 73
John Brewer Reef. Det Norske Veritas 85; Hardy & Young 96?, Hardy et al 89; Nelson 93, 94; Stark 85; Stark et al 84
Karumba. BPA wr
Kellys Beach, Woongarra. COPE
Keppel Sands. COPE
Kings Beach - Bowen. COPE
Kings Beach - Caloundra. BPA - COPE
Kirra. BPA 9-; Chapman 78
Kirra, North. COPE
Kirra Point. BPA; Murray et al 93; Robinson & Patterson 75
Kolan River. BPA
Lady Elliott Island lighthouse.
Lamberts Beach (Mackay). COPE. Masselink & Hegge 95
Lammermoor Beach, Livingstone. BPA - COPE.
Leopard Reef.
Low Isles.
Lucinda. Foster 76. BPA .
Machans Beach. BPA - COPE.
Mackay (also see Lamberts beach). BPA 79
Magnetic Island. Byrne & Riedel 83; Rasmussen 93; Riedel 86
Maroochydore. BPA - COPE
Miami.
Midge Point, Pioneer. COPE
Mission Beach - Johnstone Shire. BPA - COPE
Moffat Beach (Caloundra). Gourlay --, 75
Mooloolaba 1 & 2. COPE
Moore Park. COPE
Moore Reef
Moreton Bay. L&T 85; Mainstone & Fairman 87.
Moreton Island - North East shipping channel. BPA 88
Mulgrave Shire. BPA 84
Myrmidon Reef. Wolanski 85, 86, 94
Nelly Bay (Magnetic Island)
Nerang River. BPA (Delft 76); DH&M 80; Hails 64; Pattearson & Groves 81
Newell Beach. BPA - COPE
Nine Mile Beach (Yeppoon). Masselink 95. Masselink & Hegge 95.
Noah Creek - Douglas Shire. BPA - COPE
Noosa. COPE
Noosa Beach. BPA - COPE; Coughlan 89
Noosa Heads

Noosa Woods. COPE
Norman Reef.
North Kirra. COPE
Oak Beach, Douglas. COPE
Peregian Beach, Noosa. COPE
Point Lookout (North Stradbroke)
Point Vernon - Hervey Bay. BPA - COPE
Port Douglas. COPE
Rainbow Beach - Widgee Shire. BPA - COPE
Raine Island. Gourlay & Hacker 91
Redbill Reef (east of Mackay). Hopley 81
Repulse Bay. BPA
Ridge Shoal, Moreton Bay. Crabb & Wilkinson 1981.
Rosslyn Bay. Sobey & Rossow 77; Sobey et al 78; Stark et al 78
Salonika Beach, Sarina. COPE
Sandy Cape lighthouse.
Sarina Beach. COPE
Saunders Beach, Thuringowa. COPE
Scarness Jetty. COPE
Seaforth, Pioneer. COPE
Shelly Beach - Caloundra. BPA - COPE
Shingly Beach. BPA - COPE
Shoalwater Bay. IOE 73
Slade Point, Pioneer. COPE
South Nobby
Southport
Southport Spit. COPE
Sunshine Beach, Noosa. COPE
Sunshine Coast. BPA 82
Surfers Paradise. BPA - COPE; Phinn 91, 92; Jackson & McGrath 95
Sweers Island. Nittim 73
Tallebudgera. COPE
Tannum Sands. COPE
Teewah Beach, Noosa. COPE
Theodolite Creek, Isis. BPA - COPE
The Spit (Gold Coast)
Three Isles
Thursday Island.
Toogoom East. COPE
Torquay, Hervey Bay. COPE
Townsville (also see Cleveland Bay). BPA 79, 88; Blain et al 78, 84; Bremner et al 80; Byrne & Riedel 83; Riedel & Barlow 75; Stark 78
Trinity Beach. BPA - COPE
Tug Harbour (see Hay Point)
Tweed Heads
Tweed River. Tomlinson & Foster 86
Urangan. BPA - COPE
Weipa (see Albatross Bay and Jessica Point). BPA 83; Foster et al 72; IOE 73; Nelson 71
West Channel (see Magnetic Island, Cleveland Bay, Townsville). Byrne & Riedel 83.
West Queens Beach, Bowen. COPE
Wheeler Reef.
Woodgate. BPA - COPE
Woolanmaroo South, Mulgrave. COPE
Woorim (Bribie Island) COPE
Yabulu
Yeppoon. BPA - COPE; Masselink 73
Yonge Reef. Young 87.
Yorkey's Knob. COPE

NEW SOUTH WALES

Surf Environment Analysis (SEA) Sites (46 sites - those marked # have a SEA report - see 7.4.3)

Arrawarra Beach
#Avalon Beach
#Avoca Beach
#Bilgola Beach
#Bondi Beach
#Bronte Beach
#Collaroy Beach
#Coogee Beach
#Corindi Beach
Culburra Beach
Dee Why Beach
#Diamond Beach
#Dunbogan Beach
Elouera
Flynns
Freshwater
Jimmys Beach
Lighthouse Beach
Long Reef
Manly
#Maroubra Beach
Mona Vale
#Narooma Beach
New Brighton
#Newport Beach
#North Boambee Beach
#North Brighton Beach
North Cronulla
#North Sapphire Beach
North Steyne
Palm Beach
Park
Queenscliff
#Red Rock Beach
#Sandys Beach
#Sawtell Beach
#Scotts Beach
South Beach
South Cronulla
#South Curl Curl Beach
Tamarama
Town Beach
Wanda
Warilla
#Warriewood Beach
#Whale Beach
#Woolgoolga Beach

NEW SOUTH WALES *(Wave and Swell sites)*

New South Wales in general (BBW/Weatherex 85; BOM 93; Gardiner 75; Kemp & Douglas 81; Lawson & Youll 77; McMonagle & Fidge 81; PWD Annual Summaries; PWD 91 wave power; L&T/Weatherex 86; Reader's Digest 8-; Short 93; Thom 72; Thom et al 73; Webb 83; Webb & Bolton 87; Webb & Kulmar 89; Wyllie et al 92; Youll 76)

Aquatic Paradise canal estate. Willoughby et al 82
Athol Bay (Sydney Harbour). Cowell & Kotvojs 87
Ballina
Batemans Bay. L&T 87; PWD; Treloar et al 89; Vera-Cruz et al 90
Belmont
Bindijine Cove (see Jervis Bay)
Bombo. Stone & Gordon 70; IOE 73
Bondi Beach. Clarke & Hardie 88
Botany Bay. Abernethy & Lawson 73; Foster & Munro 63; Foster & Nelson 71; Gordon; Hydraulics Res 72; Lawson & Abernethy 75; Lawson & Atkinson 78; Nielsen & Gordon 87; L&T 73, 85, 90; LMcT 87; Lord & Nielsen 89; MSB 72; Nelson 95; Nielsen & Gordon 87; Nielsen et al 91; SPCC 79; Stone & Foster 67; Treloar 78; Treloar et al 73, 87; Treloar & Nagle 80; Trindade et al 93; Wallace 77; Willoughby 95; Willoughby et al 95*; Wilson 87; Youll 81
Brighton (Botany Bay)
Broken Bay. Hoffman et al 80; IOE 73; NSW Govt 89; Nielsen & Lord 89; Treloar & A 78
Burraneer Point
Byron Bay. BBW 86; Gordon et al 78; MHL 84; PWD 84
Callala. Posford et al 75
Camden Heads. PWD
Cape Byron.
Chiswick (Parramatta River)
Coffs Harbour. Lord & van K 81; MHL 84; PWD 84; 86*, 88
Collaroy. PWD 87
Collingwood. Posford et al 75
Cook Island
Corlette (Port Stephens). Geomarine 90; Lord & Nielsen 91
Cronulla. Foster et al 63
Crowdy Head. PWD 94
Culburra. Posford et al 75
Currumbene Creek (Jervis Bay)
Darling Road (Jervis Bay)
Deeban Spit
Dee Why Head. PWD 79
Eden (see Twofold Bay). Black & Rosenberg 91; MHL 88; PWD 88; Webb & Garland 80
Ettalong Beach (see Broken Bay, 40 km north of Sydney). Ray & Hoffman 78; Ray et al 77
Fingal Head
Fly Roads. IOE 73
Forster
Frenchman's Bay (see Botany Bay)
Gabo Island.
Garden Island seawall. Cox & Blumberg 86
Gascoyne Seamount. Real-time system being planned ???
Gladesville. Meynink & Foster 74
Green Cape.
Green Point (see Jervis Bay)
Half Tide Rocks (see Broken Bay)
Honeymoon Bay (see Jervis Bay)
Huskisson (Jervis Bay)
Hyams Beach (Jervis Bay)
Illawarra boat harbour. L&T 84, 85; PWD 85

VICTORIA

Altona. Caldwell Connell 81
Apollo Bay. Black & Rosenberg 91; Rosenberg & Black 91
Aspendale
Barwon Heads
Bastion Point (Mallacoota Inlet). Black & McShane 90
Black Pyramid.
Black Rock (Barwon Heads). McLearie & Barkley 87; PWD 81
Coode Island. VIMS 92
Cape Nelson
Cape Otway. Underwood 87
Cape Schank.
Danger Point
Delray Beach. Anscombe & Howard 91; L&T; Samson & Howard 87
Dutson Downs
Flinders (see PPB)
Frankston (see PPB)
Gabo Island. Reinson 77
Gippsland Lakes Entrance. PWD 63; Frier 71, 73
Kirk Point. VIMS 92
Long Island Point (Westernport Bay).
Lorne. Fryer 63
Mallacoota Beach. Black & McShane 90; Black et al 92; Reinson 77; Rosenberg et al 91; Simons et al 89
McGaurans Beach
Melbourne (see PPB)
Metung
Mornington
Mount Gambier
Otway Coast. Nelson & Keats 81.
Pambula. Black et al 92
Phillip Island
Point Hicks.
Point Lonsdale. Nelson & Keats 81; Noye 67
Point Roadknight. Black et al 92; Rosenberg et al 91
Point Wilson. Caldwell Connell 81; VIMS 92
Portland. L&T 8-, 95
Port Phillip Bay. Black et al 92; Black & Mourtikas 92; BOM 66; Cox et al 93; ESPPB 73; Falconer 72; Fryer 63; Hinwood; Hinwood et al 79; Jones et al 77; Ports & Harbours Div 80, 85; PWD 77, –; VIMS 90; Wilson 82
Port Wilson. VIMS 92
Queenscliff
Rosebud (see PPB)
Safety Beach. Black & Rosenberg 91*
St. Kilda. Ports & Harbours Div 80
St. Leonards. Caldwell Connell 81
St. Martha
Sandringham Harbour (PPB). Cox et al 93
Sandy Point
South Channel (PPB)
Swan Island. (PPB) Riedel & Fidge 77
The Rip (see PPB)
Torquay. Black & Rosenberg 91*
Werribee South (see PPB)
Westernport. Hooper & Spinley 91; Marsden 77
Wilson Point
Wilsons Promontory lighthouse.
Yaringa (see PPB)

BASS STRAIT

Bass Strait in general: Bailey 83, 87; Black et al 94; Blackman; Blackman et al 83*, 87; Blackman & McCowan --, 84; BOM 83; Colman et al 91; Curnow 87; Davies 60; ESSO 90; Falconer & Linforth 72; Heideman & Padman 85; Hinwood et al 82; Jones et al 79; McCormack et al 85; McCowan & Blackman 83; Perronello 74; Silbert et al 80; Spillane et al 72; Wright et al 82

Barracouta. Bailey et al 91; ESSO 90; Heideman & Padman 85
Black Pyramid. McCowan & Blackman 83
Currie (King Island). Blumberg & Cox 86 (seiche); Gaggin et al 87; Underwood 87
Deal Island.
Gabo Island. Reinson 77; Wright et al 72
Halibut.
Kingfish A
Kingfish B. Bailey et al 91; ESSO 90; Heideman & Padman 85
King Island. King Island Shipping Study 69. IOE 73
Marlin.
Port Phillip Heads. Falconer 72
Prawn. Underwood 87

TASMANIA (Underwood 87)

Bicheno. Underwood 87
Bull Bay.
Burnie. Chappell 73; L&T 8-; Underwood 87
Cape Bruny. Pendlebury & Wilson 85; Underwood 87
Cape Grim. Reid & Fandry 94.
Cape Sorell. Matthews 78; Reid 91, 92, 95; Underwood 87
Clam. Underwood 87
Devonport. Wallis & Holmes 87
Eddystone Point Lighthouse. Underwood 87
Hobart. IOE 73 (modelling of ships at berth)
Low Head. Underwood 87
Maatsuyker Island. Matthews 78; Pendlebury & Wilson 85; Underwood 87
Macquarie Harbour. Pickands & Mather 65; Waterman & Matthews 79
Port Latta (Stanley). IOE 73 - prediction by BOM; Harris et al 91.
Scamander.
Southern coast. Wyatt 64.
South west coast. Matthews 78
Spring Bay. IOE 73
Stanley. Underwood 87
Storm Bay. Reid & Fandry 94
Swansea. Underwood 87
Tasman Island. Underwood 87
Triabunna. Chappell 75

SOUTH AUSTRALIA (including Southern Ocean)

Adelaide. Byrne et al 83; Chappell 83, 89; Culver & Walker --, 83; Kinhill et al 83; Lange et al 82; Phillips 75; Tucker & Penney 89
Althorpe Island.
Cape Borda.
Cape de Couedic.
Cape Jervis. Byrne et al 75; Culver & Walker --, 83; Meynink 75
Cape Northumberland.
Cape Willoughby.
Flerieu Peninsula. Hillwood 60
Great Australian Bight. Highley & Stark 68; Kesteven & Stark 67; IOE 73; Provis & Steedman 85; Young & Gorman 95
Investigator Strait. Bye 76
Kangaroo Island. Davies 80; Hillwood 60; Short & Fotheringham 86
Macquarie Island. Summerfield 67
Murray River. Reissen & Chappell 93
Neptune Island.
Penneshaw. C&W --, 83
Port Giles. C&W --, 83
Port Lincoln.
Port Macdonnell. C&W --, 83
Port Neill. Noye 65; Tronson 74
Port Stanvac
Port Wakefield. RADAR. Anderson*
Redcliff Point. C&W --, 83
Seacliff. C&W --, 83; Walker 89
Sellicks Beach. Chappell 89
Southern Ocean. Banner et al 93; Blackman et al 83; Chelton et al 81; Hellmer & Bersch 85; Krause & Radok 77; Lee et al 92; McCowan & Blackman 83; Massel et al 95; Monaldo & Beal 95; Noye 67; Noye and Radok 66; Radok 66; Shillington 80
Spencer Gulf. Jones et al 95; Noye 84
Streaky Bay. Buchan & Russell 87; Young & Gorman 95
St. Vincent Gulf. Bye 76; Walker 89
Tickera. C&W --, 83
Wallaroo. C&W --, 83
Wirrina Beach. Chappell 89
Yorke Peninsula. Hillwood 60

SOUTH-WESTERN AUSTRALIA (Wilson Bluff [Eucla] to Shark Bay)

Abrolhos. RKS&A 77
Albany
Augusta (Flinders Bay). DM&H 87, 89, 90
Bandy Creek - Esperance. Boreham 91; Riedel & Byrne 87
Beenyup (Mullaloo). RKS&A 76
Bremer Bay
Buller River. Miller & Stone 72
Bunbury. PWD –, 73, 81; RKS&A 76*, 80; Silvester 57
Busselton. Riedel & Byrne et al; PWD 81
Cable Beach (Broome). Wright (1981).
Cape Leeuwin. Mackay 61*
Cape Naturaliste. PWD 73, 81
Cape Peron. Binnie et al 81; RKS&A 80, 81*; Steedman R399
Cockburn Sound. McCormack et al 85; MWB 77; McCowan et al 89; Nelson & Wilkinson 86; Riedel & Trajer 78; Silvester & Searle 81; Treloar et al 89; Waterman 71
Dawesville (Mandurah). Buchan & Russell 87; RKS&A 85; Steedman Ltd 86*
Denison Fishing Boat Harbour (75 km south of Geraldton). Paul 76, 81.
Dongara. Hegge & Elliott 91
Dunsborough. Riedel & Byrne 85
Esperance. Boreham 91; Hegge & Eliot 91; IOE 73; Lewis et al 90; Morison 90; Morison & Lewis 90; PWD 78, 84*; RKS&A 84
Exmouth Plateau. RKS&A 79, Buchan & Stroud 1993
Flinders Bay - see Augusta.
Fremantle. B&R 87; Brown & Morison 88; DM&H 88, 91; Jones et al; RKS&A 82*; Scott 80; Searle & Logan 78; Silvester 57
Gage Roads (Fremantle). Brown & Morison 88
Garden Island. Hicks et al 73; RKS 76; Silvester & Searle 81
Geographe Bay. McCormack et al 85; PWD 81; Riedel & Byrne 85; Searle & Logan 78
Geographic Bay (Geographe Bay ?) IOE 73
Geraldton. Harbours & Rivers Br –; IOE 73; Maunsell Nedeco 83; Miller & Stone 72; RKS&A 83; Silvester 57; Steedman Ltd 85
Guilderton (Fremantle). DMH 91.
Hillarys
HMAS Stirling. L&T 88; Treloar et al 89
Houtman/Abrolhos. France
Jervoise Bay. Barr 81; RKS&A 80, 82
Johns Creek. PWD 83.
Jurien Bay. PWD 84; Woods 83
Kalbarri. Oceanroutes 89.
Koombana Bay (Bunbury). RKS&A 76
Kwinana.
Moore River Port, Wilbinga. PWD 76; RKS&A 76
Mullaloo. RKS&A 77; RKS 76; Steedman R399
Ningaloo
North Beach. IOE 73
Oakajee River. RKS&A 81
Ocean Reef. PWD 78
Parmelia Channel (Fremantle)
Pelsart Reef. France 85
Perth (see Fremantle). Beer 83 (seiching)
Port Denison.
Port Geographe. Riedel et al
Rocky Point
Rottnest Island. Steedman R399
Rottnest shelf. Collins 88
Shark Bay. Johnson 74; Logan & Cebulski 70
Sorrento

South Scarborough Beach, Perth. Pattiaratchi et al 1993.
Swan River, Perth. Pattiaratchi & Hegge 90.
Twilight Cove (Esperance). Hegge & Elliot 91
Wilbinga (see Moore River Port)
Woolawar. Miller & Stone 72

NORTH WEST SHELF (Black et al 94; Buchan & Stroud 93; Carlson & Stroud 74; RKS&A 82; Stroud & King 75; Woodside 78)

Barrow Island. Buchan 85
Barrow Island (Tanker mooring). Buchan & Stroud 93
Barrow Island south (Sites 5, 6, 7). Buchan & Stroud 93
Barrow Island west. Buchan & Stroud 93
Bluebell. Buchan & Stroud 93
Broome. Wright 81
Cable Beach (Broome). Wright 81
Cape Cuvier. O'Brien 85; RKS&A 79
Cape Lambert. Maunsell & Partners 81
Central Gorgon. Buchan & Stroud 93
Courtenay Head. Buchan & Russell 87
Courtenay Shoal. Forde 85.
Dampier (see Mermaid Sound). Hamilton; Huppert 91; Lovell & Harper 89; O'Brien 85; RKS&A 79
Dampier Archipelago. Forde 85; Semeniuk et al 82
Dampier Archipelago Navaid 9. Buchan & Stroud 93
Dolphin Berth (Mermaid Sound). Buchan & Stroud 93
Exmouth Gulf. Steedman & Russell 86; Steedman 87
Exmouth Plateau. RKS&A 79
Fisher 1. Buchan & Stroud 93
Goodwyn. Bea 89; Harper et al 89
Griffin. Steedman Science & Eng 92
Harriet. Dames & Moore 80
Jabiru. Buchan & Stroud 93
Karratha.
King Bay (Dampier). Huppert 91
Legendre Island. Buchan & Stroud 93; RKS&A 83
Lowendal. Buchan & Stroud 93
Mermaid Sound (Dampier). Buchan 85; Buchan & Russell 87; Forde 85; Lovell & Harper 89; Maunsell & Partners 81; RKS&A 83; Sobey et al 79; Woodside 80
North Rankin A. Buchan & Stroud 93; Huppert 91; Steedman & Colman 85
Port Hedland. Hamilton; IOE 73; Newman 74; Paul & Lustig 75; Rice 87; WRL 74
Rawley Shoals. IOE 73
ROWS buoys. Remote Offshore Warning System run by Weathernews Pty Ltd (see 3.7).
Saladin A. Buchan & Stroud 93
Skua. Buchan & Stroud 93
South Scott Reef. Buchan & Stroud 93
Station A/B. Buchan & Stroud 93
Talisman. Buchan & Stroud 93
Thevenard channel. Buchan & Stroud 93
Thevenard deepwater. Buchan & Stroud 93
Thevenard mooring. Buchan & Stroud 93
Thevenard pipeline. Buchan & Stroud 93
Thevenard roller. Buchan & Stroud 93
Wandoo. Buchan & Stroud 93
Withnell Bay. Forde 85; McCormack et al 85; RKS&A 83

Appendix I.B Storm Surges

Complete entries with author names in bold appear for the first time. Entries showing only author names and locality can be found in the earlier bibliographic sections. **No specific search was made for storm surge papers during the compilation of the bibliography.**

See http://www.bom.gov.au/bmrc/meso/TCCIP/projects.html for current work on storm surge around Australia. The list does not include work on tsunamis, for which information is held at the Australian Maritime Engineering CRC at Monash University. A national study on tsunamis is being conducted by Professor Jack Rinn of the Department of Geology of Queensland University.

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Appendix I.C Seiching

See the earlier bibliographic sections for complete listings of references not in bold type. A detailed search was not made for seiche papers during the compilation of the bibliography. Professor Jon Hinwood of Monash University (personal communication) has copies of student reports on seiching prepared over the last 30 years, with longer period data taken in harbours. A huge amount of low grade data are available, with good quality long period data for Pambula, Port Phillip Bay, Gippsland Lakes, and Port Kembla. John Noye has published studies of oscillations in Lake George and the Coorong of South Australia.

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Public Works Dept (1988). [Coffs Harbour]
Sinclair Knight and Partners (1986). [Port Kembla outer harbour].
Thomas N.D. and Clarke, D.J. (1972). The two-dimensional flow oscillations of a fluid in a spindle-shaped basin; application to Port Kembla Outer Harbour, N.S.W., Australia. Australian Journal of Marine and Freshwater Research 23, 1-9.

SOUTH WESTERN AUSTRALIA

Beer T. (1983). Environmental Oceanography. Pergamon Press. 262pp. [The water between the coast and a conspicuous shoreline parallel reef system a few km off Perth seiches during strong winds - no other comments]
Lewis et al (1990). [Esperance Harbour long period standing wave oscillation over 40 s period]

Appendix I.D Wave models for specific sites

Mathematical and numerical models have been constructed for cyclones, and numerical and scale models constructed for specific sites to enable forecasting or studies. The complexity and type of the mathematical models vary considerably, from geometrically constructed refraction diagrammes to numerical spectral models. No claim is made for completeness of this listing.

CYCLONE MODELS (a selection only)
Young & Sobey (1980), Huppert (1991), Young & Hardy (1993)

WAVE MODELS FOR AUSTRALIA
WAM (United States Navy Fleet Numerical Meteorology and Oceanography Center - FNMOC)
WAMDI (BOM e.g. Bender & Leslie 1994)

WAVE MODELS FOR SPECIFIC SITES (alphabetical order)

QUEENSLAND
AIMS harbour, Cape Ferguson (south of Townsville) (Nittim and Pite 1975)
Bribie Island to Double Island Point (Hails 1964 - refraction diagramme)
Cleveland Bay (McIntyre & Associates 1974 - refraction diagrammes)
Gold Coast (Beach Protection Authority, Jackson and McGrath 1995)
Green Island (Trindade and Scott 1991 - HISWA)
Hydrographers Passage (Snowy Mountains Engineering Corporation 1984) [Flume studies]
Nerang River entrance (Dept of Harbours and Marine 1980; Pattearson & Groves 1981)
Nerang River to Cape Moreton (Hails 1964 - refraction diagramme)
Surfers Paradise (Jackson & McGrath 1995)
Tug Harbour, Hay Point (Bremner & Foster 1987)

Great Barrier Reef: "AIMS models of coral growth, wave energy and behaviour near coral reefs, have been combined with engineering analyses of submerged structures to calculate forces exerted upon massive coral colonies by cyclonic waves. These models predict when wave generated forces are sufficient to break or overturn the spherical or mushroom-shaped colonies. ... will be used to predict recent recent and historical patterns of potential disturbance to coral reefs from tropical cyclones ...." (Australian Institute of Marine Science Annual Report 1992-1993).

NEW SOUTH WALES
Batemans Bay (Treloar, Gordon and Carr 1989 - numerical refraction model)
Bondi Beach (Clarke and Hardie 1988 - refraction diagramme)
Botany Bay (Lawson, Abernethy and Treloar 1973; Maritime Services Board 1972; Nielsen et al 91; State Pollution Control Commission 1979 - scale model refraction predictions; Treloar and Nagle 1980 - scale model; Treloar, Collins & Lawson 1981; Wilson 1987; Trindade et al 1993; Willoughby et al 1995). NOTE: the Botany Bay scale model no longer exists.
Coffs Harbour (NSW Govt Coastline Development Manual - physical model; PWD 1988)
Cronulla (Foster et al 1963 - refraction diagramme)
Eden (Webb & Garland 1980)
Jervis Bay (PWD 1971; Stone & Munro 1971; Lawson and Treloar 1986, 1988; McCowan, Treloar and Crabb 1987; Hunter 1989)
Newcastle Harbour (White 1966; Lucas and Anderson 1973)
Pittwater (Kulmar and Gordon 1987)
Port Kembla (Fitzpatrick, Sinclair and Foster 1954 - prototype studies; Lucas 1962; Southwell 1981 - fixed bed studies)
Port Macquarie entrance (Dreury and Nielsen 1978 - refraction diagramme)
Tweed Heads (Wyllie & Tomlinson 1989)

VICTORIA (including Bass Strait)

Bass Strait (Davies 1960 - refraction diagramme; Blackman and McCowan 1984)
Bass Strait (Cardone wave model, FINEST wind model - BOM)
Gippsland Lakes entrance (PWD 1963 in Frier 1971)
Port Phillip Bay (VIMS 1990; Cox et al 1993)

SOUTH AUSTRALIA

Cape Jervis harbour (Meynink 1975)
Great Australian Bight (Young and Gorman 1995)
Gulf St. Vincent (Walker 1989)
Murray River mouth (Reissen and Chappell 1993)
Sellicks Beach (Chappell 1989)
Southern Ocean (McCowan & Blackman 1983)
Wirrina Beach (Chappell 1989)
Yorke Peninsula/Flerieu Peninsula/Kangaroo Island (Hillwood 1960 - refraction diagramme)

WESTERN AUSTRALIA (rf = refraction diagramme)

Abrolhos (France 1985 - rfs)
Bunbury to C. Naturaliste (PWD 19xx Plan Book 52138 - rf)
Busselton (Riedel & Byrne 1988? - rf)
Cape Cuvier (O'Brien 1985)
Cockburn Sound, HMAS Stirling (Treloar, McCowan and Navalli 1989)
Dampier Peninsula (Buchan and Stroud 1993 - rf)
Esperance (Lewis et al 1990; Morison 90; Morison & Lewis 90)
Exmouth Gulf (Steedman & Russell 1986 - rf)
Jurien Bay (PWD 1984 - rf)
Pelsart Reef (France 1985 - rf)
Port Hedland Harbour (Water Research Laboratory 1974 - hydraulic model study: cyclonic wave penetration)

NORTHERN TERRITORY

Darwin Harbour (Scott 1985 - numerical refraction model; AWACS & Patterson Britton for Dept of Transport N.T.)

APPENDIX II. INSTITUTIONS NAMED IN THIS REPORT

This list shows most institutions appearing in this report, regardless of whether they were authors, commissioners of reports, data gatherers, or data suppliers. For Australia the state associated with the organization is shown, sometimes with an address. In some cases the state shown is where work was performed, not the home state of the institution. Some of these institutions may no longer exist, or may have changed name. Details of consulting engineers can be found e.g. in the **"National Directory Consulting Engineers 1982-83"** published by the Association of Consulting Engineers Australia, then at 75 Miller Street, North Sydney, and other states.

Australia and States (alphabetical order by institution name)

COMPANIES

[NT] Acer Vaughan Pty Ltd, 6th floor, Capita Bldg, 62 Cavanagh St, Darwin NT 0800.

[NT] AIEDA [Director Tony Cockburn], 22/5 Poinciana St, Nightcliff N.T. 0810

[NT] Alex MacKnight and Associates

AMPOL (Australian Oil Refinery, Botany Bay)

Australian Hydrographic Services Pty Ltd

Bechtel Pacific Corporation Ltd

[VIC] BHP Petroleum Pty Ltd

[VIC] Binnie & Partners Pty Ltd

Binnie (International) Australia Pty Ltd

[QLD] Blain Bremner and Williams Pty Ltd

Burchill and Partners Pty Ltd

Caldwell Connell Engineers.

[SA] Chappell Engineers Pty Ltd

[WA] Cliffs Western Mining Co P/L

Clutha Development Pty Ltd

[WA] Coastal Information And Engineering Services,
Marine House, 1 Essex Street, Fremantle, Western Australia 6160.

[QLD] Colonial Sugar Refining Co. Ltd

[QLD] Comalco Pty Ltd

Costain-Pearson Bridge

[QLD] Cullen, Grummett & Rowe, Geotechnical & Mining,
72 Kelvin Grove Road, Normanby, Brisbane

Dames and Moore

[WA] Dampier Salt Limited

[NSW] Det Norske Veritas, Level 2, 165 Walker St., North Sydney NSW 2060

[NSW] DN Foster and Associates

[NSW] EA Books, 54 Alexander Street (PO Box 588), Crows Nest, NSW 2065.
{for Institution of Engineers publications}

Engineers Laboratories Pty Ltd
[NSW] Envoronmental Protection Agency NSW, 66-70 Rickard St, Bankstown NSW 2200
EPPP

ESSO Australia Ltd

[NSW] Geomarine Pty Ltd, Sydney.

[VIC] Global Environmental Modelling Services Pty Ltd, Melbourne.

[QLD] Golder & Associates, 126 Wickham Terrace, Brisbane

[WA] Hammersley Iron

ICI Australia Engineering P/L

[AUS] Institution of Engineers, Australia. 11 National Circuit, Barton A.C.T. 2600

[WA] Kaiser Aetna Australia Pty Ltd

[SA] Kangaroo Island Ferry Co-ordinating Committee, South Australia

[SA] Kinhill Engineers Pty Ltd, 200 East Terrace, Adelaide SA 5000

[QLD] Kinhill, Riedel and Byrne, PO Box 1197, Milton, QLD 4064.

[SA] Kinhill Stearns

Lange, Dames & Campbell

[WA] Laporte Australia P/L

[NSW] Lawson and Treloar Pty Ltd, Coastal, Ocean and Water Resources Consulting Engineers
199 Pacific Highway, North Sydney 2060. [PO Box 799, North Sydney NSW 2060]

Leighton-Candac Nerang P/L

Macarthur River Mining

[QLD] McIntyre & Associates

[VIC] MacKnight Pty Ltd, Suite 7, 11 Beach St., Port Melbourne, VIC 3207

[WA] Maunsell & Partners Pty Ltd, Perth.

[WA] Maunsell-Nedeco

[QLD] McIntyre & Associates

Meagher and Le Provost

Munro Johnson and Associates

[QLD] Naturally Queensland Bookshop, Ground Floor 160 Ann Street, Brisbane QLD 4000
Phone: (07)32278185. {for Beach Protection Authority reports}

[WA] Oceanroutes (now Weather News Inc)

[NSW] Patterson Britton & Partners Pty Ltd, Level 2, 104 Mount St, North Sydney 2060.

[TAS] Pickand Mather & Co

Posford, Pavry, Sinclair and Knight

[QLD] Queensland Nickel P/L

[VIC] Rendel, Scott & Furphy (Consulting Engineers) {UNCHECKED}
390 St. Kilda Road, Melbourne Victoria 3004.

[WA] Riedel and Byrne Consulting Engineers Pty Ltd, Subiaco

[WA] R.K. Steedman & Associates (now Weather News Inc)

[SA] (The) Royal Society of South Australia

Scott & Furphy Engineers

Scott & Furphy Group Of Companies

Shell Company of Australia

Shell Exploration

Stearns

[NSW] Sinclair Knight and Partners Pty Ltd, Consulting Engineers
1 Chandos St, St Leonards NSW 2065

[WA] Steedman Limited (now Weather News Inc)

[WA] Steedman Science and Engineering (now Weather News Inc)

[VIC] VIPAC Engineers & Scientists Ltd, 275 Normanby Road, Port Melbourne VIC 3207

[NSW] Weatherex Meteorological Services Pty Ltd

Weather News Incorporated (WNI)
{formerly OceanRoutes, and previously Steedman Science and Engineering}
A division of Weathernews Pty Ltd
31 Bishop Street, Jolimont WA 6014

[WA] Woodside Petroleum Ltd {UNCHECKED}
1 Adelaide Tce, Perth W.A. 6000

PORT AND HARBOUR AUTHORITIES AND MARINE BOARDS

[AUS] Australian Port Authorities Association
[WA] Bunbury Port Authority
[WA] Dampier Port Authority, PO Box 285, Dampier, WA 6713
[NT] Darwin Port Authority (previously Northern Territory Port Authority),
GPO Box 390, Darwin, NT 0801
[WA] Fremantle Port Authority, PO Box 95, Fremantle, WA 6160
[WA] Geraldton Port Authority
[QLD] Gladstone Port Authority

[NSW] Maritime Services Board of New South Wales

[NSW] MSB Sydney Ports Authority, GPO Box 32, Sydney, NSW 2001

[WA] Port Hedland Port Authority, PO Box 2, Port Hedland, WA 6721

[VIC] Portland Harbour Trust
Now: Port of Portland Authority
P.O. Box 292, Portland, Victoria 3305

[SA] Port of Adelaide Authority, PO Box 19, Port Adelaide, SA 5015

[QLD] Port of Brisbane Authority. GPO Box 1818, Brisbane, QLD 4001
[QLD] Port of Brisbane Corporation

[VIC] Port Of Melbourne Authority, Building A, World Trade Centre, Melbourne.
GPO Box 4721, Melbourne VIC 3001

[NSW] Sydney Ports Corporation, Maritime Services Board Of New South Wales
207 Kent Street, Sydney 2000

[QLD] Townsville Harbour Board, Townsville, Queensland 4810.
[QLD] Townsville Port Authority, Townsville, Queensland 4810.

COMMONWEALTH AND STATE GOVERNMENT DEPARTMENTS

[QLD] Department of Environment and Heritage
1. Beach Protection Authority Queensland
Dept of Environment and Heritage
Floor 5, 160 Ann Street, Brisbane, QLD 4001
2. Coastal Management Branch

[AUS] Dept of Administrative Services (including Construction Group)

[VIC] Department of Construction {UNCHECKED}
Maritime Works Section, 17 Yarra Street, Hawthorn Melbourne VIC 3122

[AUS] Dept of Defence
[VIC] Dept of Fisheries and Wildlife
[QLD] Department Of Harbours And Marine
Edward Street, Brisbane, Queensland

[AUS] Department of Housing and Construction (also Department of Construction)
(now Dept of Administrative Services)
Maritime Works Branch, A.C.T.

[NT] Dept of Lands, Housing & Local Government

[SA] Department Of Marine and Harbours, South Australia {UNCHECKED}
P.O. Box 19, Port Adelaide S.A. 5015

[NT] Dept of Transport and Construction (Maritime Works Branch)

[WA] Department Of Transport Western Australia
(formerly Harbours And Marine), 1 Essex St, Fremantle W.A. 6160

[NSW] Dept of Land and Water Conservation

[NT] Dept of Transport and Works, GPO Box 2520, Darwin N.T. 0801

Eurobodalla Shire Council

[QLD] Gold Coast City Council
[WA] Harbours and Rivers Branch, Public Works Dept of Western Australia

[NSW] Public Works Department of New South Wales (now Public Works and Services)
including at various times:
Coastal Branch
Coastal Engineering Branch
Coast and Rivers Branch
Harbours and Rivers Branch
Hydraulics and Soil Laboratory
Manly Hydraulics Laboratory

[WA] Public Works Department of Western Australia (disbanded on June 30 1985)

[SA] High Frequency Radar Division DSTO, Salisbury S.A.

[TAS] Hydro-Electric Commission of Tasmania

[NSW] NSW Coastal Council
[NSW] NSW Institute of Technology
[VIC] Melbourne and Metropolitan Board of Works
[WA] MWSSDB
[NT] Northern Territory Dept of Lands

[NSW] Port Kembla Task Force

[QLD] Queensland Water Resources Commission

[AUS] Royal Australian Navy

[WA] Shire of Wanneroo

[NSW] Shoalhaven Shire Council

Snowy Mountains Engineering Corporation

[SA] South Australian Coast Protection Board.

[VIC] State Electricity Commission of Victoria

[NSW] Sydney Water Board
[TAS] Tasmanian National Parks and Wildlife
[NSW] Tourism Commission of New South Wales

LABORATORIES

Aeronautical and Maritime Research Laboratory, DSTO
Maritime Operations Division, P.O. Box 44, Pyrmont, NSW 2009

[QLD] Australian Institute of Marine Science (AIMS)
Cape Ferguson, Queensland, Australia
PMB No. 3, Townsville Mail Centre QLD 4810

[AUS] Australian Maritime Engineering CRC Ltd
Monash University, Wellington Road, Clayton VIC 3168

[AUS] Australian Oceanographic Data Centre
Level 2, Maritime Headquarters Annex, Wylde Street, Potts Point NSW 2011

[NSW] Australian Water and Coastal Studies Pty Ltd (AWACS)
110 King St, Manly Vale NSW 2093

[AUS] Bureau Of Meteorology, GPO Box 1289K, Melbourne VIC 3001
(1. Oceanographic Systems Development Section, National Meteorological Centre)
(2. Publications Subsection)
(3. Specialised Oceanographic Centre)
Central Studies Establishment

[TAS] CSIRO Marine Laboratories, GPO Box 1538, Hobart TAS 2001

[NSW] Manly Hydraulics Laboratory, NSW Dept of Public Works and Services
110B King St, Manly Vale NSW 2093

Materials Research Laboratory, Defence Science and Technology Organisation (DSTO), Dept of Defence (now Aeronautical and Maritime Research Laboratory)

[VIC] Public Works Department
Ports and Harbours Division, Marine Models Laboratory, 119 Salmon Street, Port Melbourne, Victoria 3207. {DEFUNCT}

[QLD] Queensland Government Hydraulics Laboratory

[VIC] Victorian Institute of Marine Sciences (VIMS)
23 St Andrews Place, East Melbourne, Victoria 3002.
(Email: vims@peg.apc.org)

[NSW] Water Research Laboratory
The University of New South Wales
King St, Manly Vale NSW 2093.

UNIVERSITIES, UNIVERSITY INSTITUTES, AND UNIVERSITY COLLEGES

[TAS] Australian Maritime College, PO Box 986, Launceston TAS 7250

[WA] Curtin University of Technology, Bentley, WA 6102

[SA] Flinders Institute for Atmospheric and Marine Science, The Flinders University of South Australia, Bedford Park, South Australia 5042.
(GPO Box 2100, Adelaide S.A. 5001)

[ACT] Australian Defence Force Academy
Canberra A.C.T. 2600

[SA] Horace Lamb Centre for Oceanographical Research
Flinders University of South Australia

[QLD] James Cook University of North Queensland
Townsville, Queensland 4811
(PMB 3, Townsville Mail Centre QLD 4810)
1. Department of Civil and Systems Engineering
2. Department Of Geography
3. Department Of Geology
4. Department of Physics.

[VIC] Monash University (Dept of Mechanical Engineering)

[SA] University Of Adelaide
P.O. Box 498, Adelaide, South Australia 5001.
Department of Civil Engineering

[VIC] The University of Melbourne
School Of Environmental Planning
Parkville Victoria 3052 (see O'Brien 1985)

[NSW] University of New South Wales, Kensington, NSW

[QLD] University Of Queensland, St. Lucia, Brisbane.
Department of Civil Engineering

[NSW] University of Sydney (Coastal Studies Unit, Dept of Geography)

[WA] University of Western Australia
1. Centre for Water Research
2. Dept of Geology

[NSW] Wollongong University College, Dept of Mathematics
[NSW} Wollongong University

International

British Oceanographic Data Centre, Proudman Oceanographic Laboratory
Bidston, Birkenhead, L43 7RA, United Kingdom

Datawell (waverider buoy manufacturers)

Delft Hydraulics Laboratory, The Netherlands

Department of Transport, Works and Supply {UNCHECKED}
P.O. Box 2457 Komedobu, Papua, New Guinea

EG&G International Inc

Elsevier Science Ltd, The Boulevarde, Langford Lane, Kidlington, Oxford, OX5 1 GB, England

European Space Agency

FNMOC (United States Navy Fleet Numerical Meteorology and Oceanography Center)

Hydraulic Research Station, Wallingford. U.K. Ministry of Technology.

Interocean (S4 current meter)

Jet Propulsion Laboratory
California Institute of Technology, Pasadena, California

Marsh-McBirney (current meters)

NASA (National Aeronautics and Space Administration)

Oceanographic Services Inc

OCEANOR, Satellite Application Group, Pir-Senteret, N-7005 Trondheim, Norway.

Permanent International Association of Navigation Congresses. "List of Sea State Parameters" through International Association for Hydraulic Research, January 1986. Available from General Secretariat of PIANC, Residence Palace, Quartier Jordaens, Rue de la Loi 155, 1040 BRUSSELS, Belgium.

Scientific Co-ordinator
RNODC (Waves)
Institute Of Oceanographic Sciences (IOS)
Wormley, Godalming. Surrey GU8 5UB U.K.

U.S. Army Coastal Engineering Research Centre (CERC).

U.S. Navy

APPENDIX III. LIST OF AUSTRALIAN & AUSTRALASIAN CONFERENCES ON COASTAL AND OCEAN ENGINEERING CONDUCTED BY THE INSTITUTION OF ENGINEERS AUSTRALIA.

These are Specialist Conferences held by the Institution Of Engineers, Australia. Many of the papers deal with coastal wave data and analysis, and anyone studying waves around Australia is recommended to examine these publications. The conferences were first designated Australian, and later as Australasian (7th onwards). The 17th International Conference Proceedings were also published by the Institution Of Engineers. The publications can be purchased from EA Books, 54 Alexander Street (PO Box 588), Crows Nest, NSW 2065. Information on waves can occasionally also be found in *Australasian Port and Harbour Conference* proceedings.

<u>Australian</u>

First Australian Conference on Coastal and Ocean Engineering.
Engineering dynamics of the coastal zone.
Sydney, 14-17 May 1973. N.C.P. 73/1. 244pp.
(N.C.P. = National Conference Publication)

Second Australian Conference on Coastal and Ocean Engineering.
The engineer, the coast, and the ocean.
Gold Coast, Queensland, 27April-1May 1975. N.C.P. 75/2. 233pp.

Third Australian Conference on Coastal and Ocean Engineering
The coast, the ocean, and man.
Melbourne, 18-21 April 1977. N.C.P. 77/2. 252pp.

Fourth Australian Conference on Coastal and Ocean Engineering
Managing the coast.
Adelaide, 8-10 November 1978. N.C.P. 78/11. 246pp.

Fifth Australian Conference on Coastal and Ocean Engineering
Offshore structures. Perth, 25-27 November 1981.
Two publications with different versions of some papers:
(1) Abstracts-in-depth (preprints) N.C.P. 81/15. 167pp.
(2) Also N.C.P. 81/16 Proceedings 304pp

Sixth Australian Conference on Coastal and Ocean Engineering
Resources Development - Role of coastal and ocean engineers
Gold Coast 13-15 July 1983. Preprints Of Papers.
(No N.C.P. number shown on the document) ISBN 0 85825 197 3

Australasian

7th Australasian Conference on Coastal and Ocean Engineering
Christchurch, New Zealand, 2-6 December 1985
Volume 1 - 618pp
Volume 2 - 556pp

8th Australasian Conference on Coastal and Ocean Engineering
Launceston, Tasmania. 30 November - 14 December 1987. Preprints Of Papers. N.C.P. No. 87/17. 452pp, plus discussions on 1985 conference papers.

9th Australasian Conference on Coastal and Ocean Engineering
Adelaide, 4-8 December 1989. Preprints Of Papers. N.C.P. 89/20. 416pp + listing of abstracts.

Proceedings of 10th Australasian conference on coastal and ocean engineering. Coastal Engineering - Climate For Change. Auckland - New Zealand. 2nd - 6th December 1991. Water Quality Centre Publication No. 21, DSIR Marine and Freshwater, Hamilton, N.Z. RICE Printers, Hamilton.

Eleventh Australasian Conference on Coastal and Ocean Engineering.
Coastal Engineering - a partnership with nature. 23-27 August 1993, Townsville. N.C.P. 93/4.

12th Australasian coastal and ocean engineering conference. Combined with 5th Australasian Port and Harbour Conference. Preprints Of Papers. Melbourne, 28May-02June 1995. N.C.P. 95/5. 510pp.

International

17th International Conference On Coastal Engineering
Sydney 23-28 March 1980.
Abstracts-In-Depth. N.C.P. 80/1. 452pp.
{There is also a Supplement}

APPENDIX IV. GENERAL SEA CONDITIONS AROUND AUSTRALIA

The opportunity has been taken to compile some of the observations noted during the making of this bibliography, however detailed synthesis and review have not been undertaken. The appendix forms a general introduction to the wave climate around Australia and its causes, with particular details for some specific sites.

The 'Average' Wave Climate Of Australia

For the Australian region the very broad picture of the wave climate is that of gentle wave conditions in the north, with conditions increasing in severity with latitude until the stormiest parts of the world oceans are reached at about 50°S. On the average significant wave heights are less than 1.5 m for 50-70% of the time in northern Australia, but larger than 3.5 m for 30-50% of the time along much of the southern coastline (McMillan 1982, quoted in Harris et al 1991). This pattern is often well shown by the quasi-synoptic global coverage obtained by satellite borne sensors e.g. Fig IV.1 .

However this average picture is disrupted by violent summer cyclones in the tropical north, and by occasional long calms, or stronger storms than usual, in southern latitudes. The average pattern of low waves for the north is in sharp contrast to the maximum wave heights predicted for 50 and 100 year return periods e.g. Fig IV.2, which is related to the occurrence of cyclones (Fig IV.3). In other areas a similar contrast is seen from comparison of maximum recorded heights with the average pattern. A better understanding of the wave climate is obtained by considering it in terms of calms interspersed with storms, with the northern region having longer periods of calms (for up to 9 months of the year). The southern regions have shorter return periods for storms (about 17 days off Sydney for storms generating Hsig over 2.5 m). The 'average' wave climate is formed from a series of episodic events and extreme spasmodic events, and the picture formed by averaging such events can be quite misleading.

General Causes Of The 'Average' Wave Climate Of Australia

The average pattern of the wave climate for Australia is brought about by two major factors: (1) the average wind and weather patterns, which are seasonal, and (2) the orientation of the various parts of the coast to prevailing winds and swells, coupled with bathymetry. In the tropical north on both sides of Australia there are wide continental shelves (Fig IV.4), shallow depths, and features such as the Great Barrier Reef. These combine to protect the northern coasts from swells by energy losses during diffraction through reef passages, reflection, refraction, and shoaling. South of about 30°S the continental shelf narrows on both sides of Australia, and on the east side the Great Barrier Reef terminates, and both coasts are subject to the full effects of swells. On the west side there are some shallow, discontinuous shore parallel ridge systems which provide some protection, but not to the extent of the Great Barrier Reef.

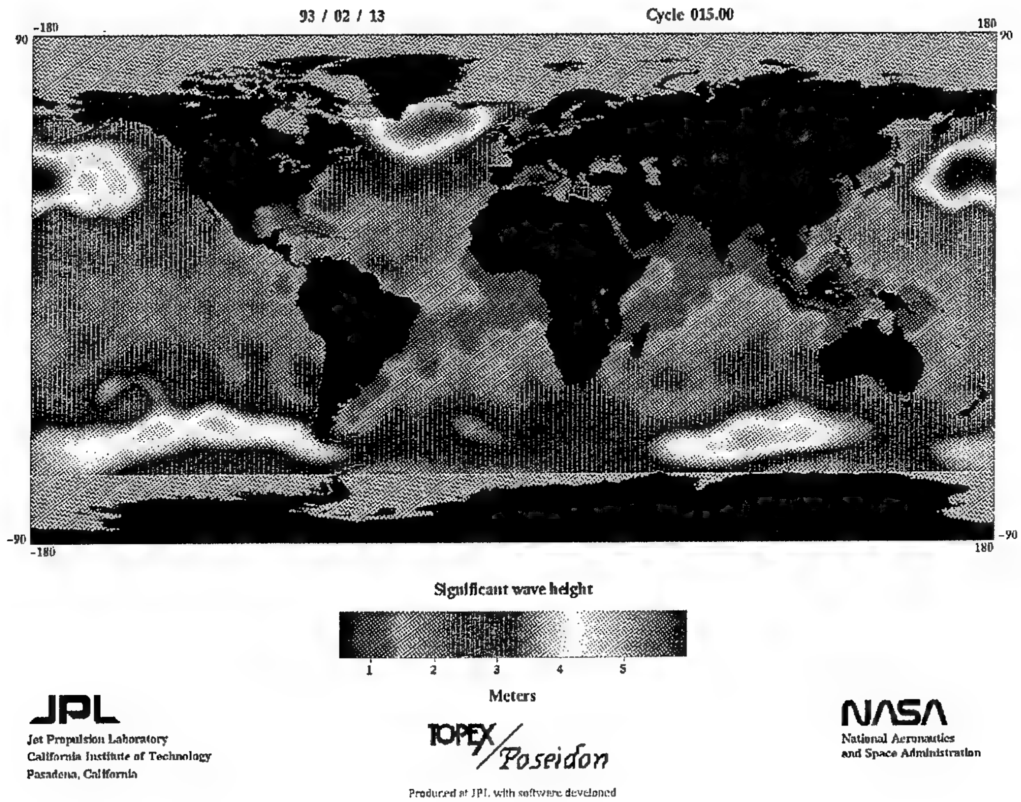


Fig. IV.1. The 'average' wave climate of Australia as shown by a snapshot of TOPEX/Poseidon altimeter data. Low waves occur in Australia's tropical north, with increasing severity to the south until the stormiest part of the globe in the Southern Ocean. Note the severe conditions southwest of Australia in the Vendee Globe Challenge yacht race disaster area.

NOTE THAT A LISTING IN THIS DOCUMENT FOR DATA OR REPORTS DOES NOT NECESSARILY MEAN THAT THE DATA OR REPORTS ARE AVAILABLE FOR PUBLIC USE OR PERUSAL, OR THAT DATA OR REPORTS ARE FREE OF CHARGE. REQUESTS FOR DATA OR INFORMATION SHOULD NOT BE MADE TO DSTO, BUT DIRECTLY TO THE ORGANISATIONS WHICH GATHERED THE DATA.

NOTE: If you have data information or reports that could be listed in this document, please send details to the author at Aeronautical and Maritime Research Laboratory, DSTO, P.O. Box 44, Pyrmont, NSW 2009, AUSTRALIA (preferably on a DOS diskette in ASCII or WORD for Windows format; or email ASCII text to les.hamilton@dsto.defence.gov.au).

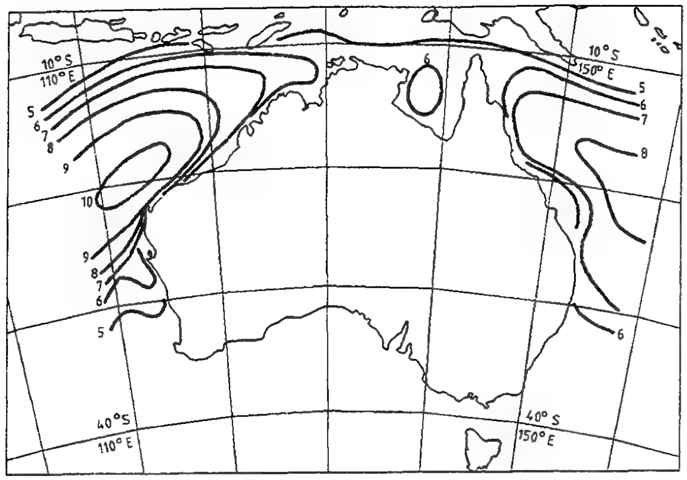


Fig IV.2. Significant wave heights forecast for 50 year return storms (Dexter and Watson 1976).

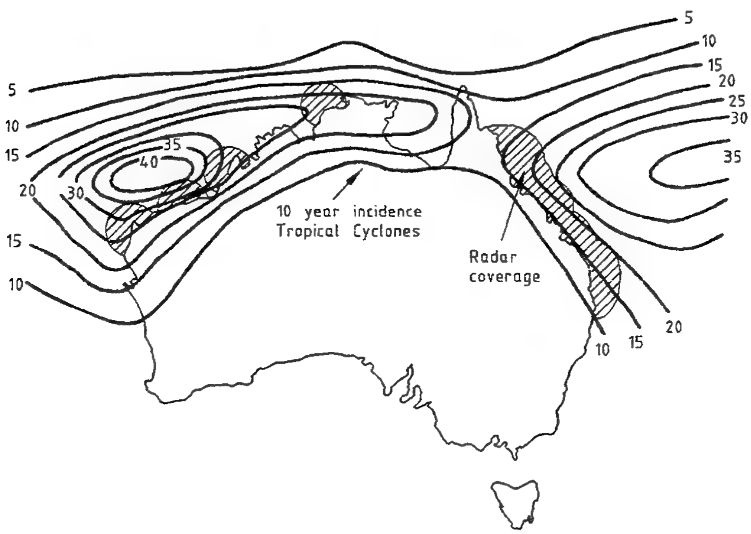


Fig. IV.3. Ten year incidence of tropical cyclones [See R. Lourensz (1977). Tropical cyclones in the Australian region, July 1909-June 1975. Meteorological Summary, Commonwealth Bureau of Meteorology, Australia]

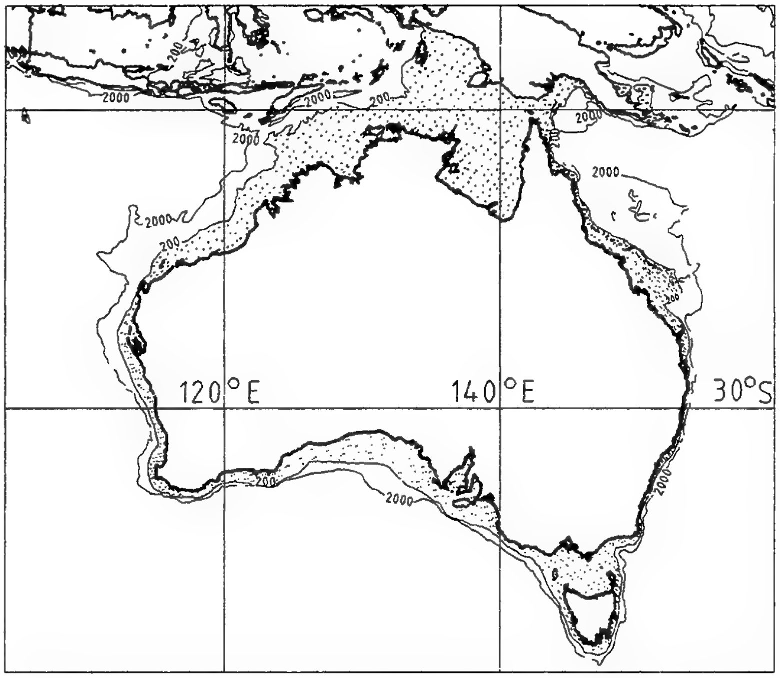


Fig. IV.4. Australia's continental shelf as delineated by the 200 m isobath.

Average Wind And Weather Patterns

Average wind and weather patterns show the following main features: (1) Tropical cyclones (November to March). (2) Summer monsoons (November to March). (3) South-East Trade winds from March/April to October/November north of about 30°S. (4) A regular processon of anti-clockwise circulating highs moving from west to east (along about 30°S in summer and 25°S in winter) at about one per week, the anti-cyclone belt, most marked during winter. In average pressure patterns the movements of the highs lead to a ridge, which migrates north in winter with the Inter Tropical Convergence Zone. The cyclic passage of the highs, which are separated by troughs of low pressure, brings an episodic nature to the wave and swell events at any location. However on occasions a high can remain stationary for several days. (5) The Roaring Forties or strong westerly winds, and (6) the Howling Fifties, both marked by the west to east passage of strong lows and frontal systems. (7) Land and sea-breezes are an important source of waves in many areas. The initial direction of swell propagation in the southern hemisphere is in the general direction of the wind, with the Coriolis force adding an anti-clockwise motion for longer periods. A wind blowing to the east can generate swell moving to the east-north-east to north-east for example.

In the north the SE Trades are not generally major causes of coastal swell. On the west coast they blow from the land and the resulting short fetches are usually insufficient to generate much wave or swell near the coast. Occasionally however a low (or infrequently a high) becomes anchored to the coastline along the northwest shelf with e.g. the centre near Port Hedland, and the subsequent elongation of the low pattern parallel to the coastline allows sufficient fetch and duration for wave generation at 4-8 s periods (Hamilton 1997). On the east coast the Great Barrier Reef severely attenuates long period swell, although some swell penetrates through reef passages. There is sufficient fetch (≈ 200km) for swell of about 4 seconds period to be generated inside the Great Barrier Reef lagoon. Heights seldom exceed 2.5 m except in cyclone events.

The south and southwest of Australia are subject to south-westerly swell generated by winds (the westerlies) with the longest fetches in the world, and receive high wave power all year. On the east these swells tend to run up the coastline. North of about 30°S in the west, the orientation of the coastline changes from north-south to be from southwest to northeast. Coupled with the wide north west shelf (Fig IV.4), this greatly reduces the effects of south-westerly swells. Refracted swells reach Dampier and Port Hedland from the west and northwest with periods of 12-20 s, but with heights less than 0.5 m for much of the year. The northward winter migration of the anti-cyclone belt brings increased swell to northern areas in midyear.

Further details are given in the following discussion.

Regional Wave and Swell Regimes

Great Barrier Reef

Seas are usually slight to moderate, being protected from ocean swell by reefs. Summer cyclones (December to April) generate strong winds, rough seas and storm surges. This is also the time of the Northwest Monsoon, which reaches Torres Strait about the middle of December, and the effects of which are occasionally felt to as far south as Cairns. Swell generated in the Coral Sea by the winter South East Trades propagates from the southeast and impacts on the shelf edge barrier reefs. Some penetrates through reef openings.

Because of the shielding effect of the Reef, locally generated waves are the main determinant of wave conditions. "There is a moderately rapid response of wave conditions to changes in wind condition. A pronounced diurnal variation in the wind climate is reflected in the wave climate, and the stability of the region's tropical climate leads to frequent calm to slight sea conditions. This stability is occasionally exploded by ... a tropical cyclone in mid to late summer when large waves, ... may be generated" (Sobey 1978). Waves breaking on some island beaches are limited in height by water depths over the reef flats (Gourlay and Hacker 1991).

Gulf Of Carpentaria

BOM (1966): The gulf is relatively shallow and over a large area is little more than 60 m deep. Consistent South East trades occur from April to September. Generally light winds occur in the remainder of the year, with brief periods of cyclone activity. The trade winds exhibit strong constancy of direction, seldom varying more than from south-southeast to east-southeast. From September to October the trade winds degenerate, wind fields lack organization and strength, and seas seldom exceed 2 feet. From December to April tropical depressions may occur, with highly organized wind fields, and wind speeds approaching gale force. The most severe situation for seas and winds will occur when an intense tropical cyclone develops near Thursday Island and moves in a west-south westerly direction to pass to the north of Gove. Approximately three times every wet season wind fields become organized and strengthen. Usually the depressions do not reach gale force, but this may happen every second year (wind speed over 35 knots). Less frequently tropical cyclones of real severity occur.

Small tropical cyclones (mean winds near the centre greater than 35 knots) occur about once every two years at Gove, and can cause waves with Hsig of 12 feet and 8 s period, with Hsig up to 30 feet and period 14 s for the more intense cases. Tropical depressions with winds under 35 knots form north and east of Gove, a favoured area of cyclogenesis, perhaps two or three times a year, causing Hsig of 12-14 feet and period 8-10 s, with these conditions persisting for up to 2-3 days. Whenever a tropical depression or tropical cyclone forms, equatorward of the

disturbance the northwest monsoon strengthens, leading to 20 knot winds at Gove from the northwest to north-northwest. This can cause Hsig of 6-8 feet, and 6-7 s period from the north-northwest. This situation may last for up to 4 to 5 days. Strong land-sea breezes occur at the coast during the southeast trades e.g. at Gove there is a tendency for the prevailing wind to be affected by a south westerly land breeze component overnight, and by a north-easterly sea breeze component during the day.

Cairns

Bi-modal wave spectra, with spectral peaks at 4 and 9 s, were found in shallow coastal waters off Cairns (Murray and Ford 1983). The peaks arose from south-easterly sea generated inside the reefs, and south-easterly swell from outside the reef which penetrated through Trinity Opening to approach from the north-east at reduced height. A lesser amount of swell came from the southeast through Grafton Passage (Fig IV.5). Bi-spectra occurred for less than 4 percent of the time at a site on the 20 m contour, and for less than 2% at a more protected inshore site. At Green Island average wave heights rarely exceed 0.7 m, with the most predominant conditions being 0.1-0.2 m and 2-4 s from local winds. A maximum of 1.5 m at Green Island was recorded in COPE visual observations from February 1983 to September 1987 (BPA 1989).

Cleveland Bay (Townsville)

Waverider data outside the bay north of Cape Cleveland show that waves between 0.5 to 1.2 m height and 4-6 s periods occur for 60% of the time. Maximum wave heights are associated with cyclones; a height of 4.7 m was measured in 1979 for Cyclone Peter; and 6.1 m for cyclone Althea off Cape Cleveland. Wave heights inside the bay are usually lower than outside, being protected from southeasterly swell by C. Cleveland and northeasterly swell by Magnetic Island (Carter and Johnson 1987, quoted in Harris et al 1991). Nelly Bay on east Magnetic Island receives typically short period local waves (2-4 s) with heights under 1 m, and refracted swell generated inside the reef (Riedel 1986). McIntyre and Associates (1974) took a swell period of 5 s as being typical for Cleveland Bay. They discuss low water refraction patterns for north-easterly, easterly, and south-easterly waves. The refraction diagrammes and BPA information are reproduced in Pringle (1989). For data for November 1975 to December 1988 waves with Hsig of 0.2-0.4 m and 3-5 s peak energy period occurred most frequently. Blain, Bremner and Williams (1984) computed design wave heights of 4.25 and 4.55 m for 50 and 100 year returns, lower than those quoted above for cyclones Peter and Althea.

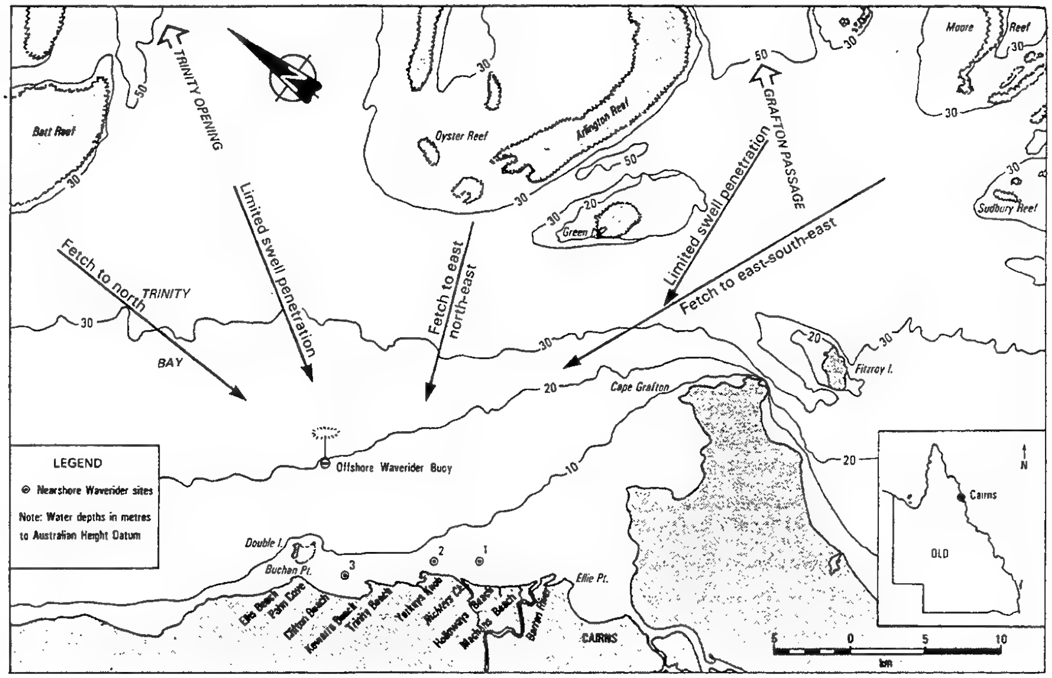


Fig IV.5. Wave directions near Cairns (Murray and Ford 1983).

Lambert's Beach (Mackay)

The offshore wave climate is characterised by a modal wave height of 0.6 m and period 5 s (Masselink and Hegge 1995 quoting BPA 1986).

Capricorn Coast

On the Capricorn coast ocean swell and local sea have been identified as two quite separate wave populations. This is because of the partial shelter provided by the Great Barrier Reef and the shape of the Queensland coastline, together with the great width of the continental shelf in the vicinity of the Capricorn coast (Patterson and Ford 1980). At Heron Island average wave heights rarely exceed 0.8 m (BPA 1989).

Yeppoon

On Nine Mile Beach the offshore wave climate is characterised by a modal wave height of 0.75 m and period 6 s (Masselink 1995). The position of Nine Mile Beach opposite the Capricorn Channel enables swell to reach the shoreline relatively attenuated, and the beach experiences the highest wave energy on the Central Queensland coast (Masselink and Hegge 1995 quoting BPA 1979). At Kinka and Mulambin beaches south of Yeppoon, the predominant swell direction is from slightly south of east (Grigg et al 1989).

Southern Queensland and Northern New South Wales

Harris et al (1991) provide some general comments. See Blain et al (1980) for a description of storms affecting the southern Queensland and northern NSW coasts. The southern Queensland and northern NSW coast receive tropical cyclone generated waves which propagate from the east to northeast during February and March. In New South Wales, waves are dominantly southerly and south-easterly, 1.5 m in height and 10 seconds in period, with much larger waves experienced during storm events. More details are given in the descriptions for the Gold Coast and New South Wales.

Gold Coast

The Gold Coast is exposed to moderately high wave energy, dominantly in the form of east to southeast swell, for most of the year (Chapman and Smith 1983). Significant wave heights 1.5 km offshore from The Spit (Gold Coast) in the storms of April 1989 were 5-6 m with a maximum wave of 11 m. At Noosa Beach 120 m offshore a maximum storm wave height of 4 m and significant wave heights of 1.5-2.6 m were recorded (BPA Annual Report 1989). Pattearson and Patterson (1983) found that about 30% of spectra were bimodal, with the second peak usually containing 10-40% of the energy of the major peak.

The weather systems contributing to the wave climate are highs in the Tasman Sea, seabreezes to 20-25 knots, cyclones and rain depressions. In summer the highs are less intense, the sea breezes dominant and cyclones likely. This usually generates short swell (7-11 s) up to 10 feet high, usually with a strong local sea superimposed. Cyclones may cause further height increases. In winter the local sea breezes are less marked and Tasman Sea highs are more intense and usually more persistent. Cyclones are not as likely in this time, but can occur as deep rain depressions. Winter waves are consequently often of longer period (8-13 s spectral peak period), and up to about 10 feet as for summer. Cyclones have generated waves up to 19.6 feet, with Hsig above 16 feet maintained for 2 days. The "average" wave is 4 feet with 9-10 s peak period (McGrath and Patterson 1973). Hsig was highest in February-March (from cyclone activity) and in November-December. Pattearson and Groves (1981) chose cyclone design waves of 6-7 m and 11.3-11.7 s period.

Phinn (1991, 1992) classed the wave producing weather systems for Surfers Paradise into eight synoptic types (of four groups), with five wave-power classes. The sea-breeze was not allowed for, but variations in wave conditions were attributed to cyclonic systems in the Coral Sea and latitudinal variation in the passage of anti-cyclones. "This contrasts with the variations in wave conditions experienced on the central and southern NSW coasts, which are controlled by inter-anticyclonic features and cyclones in the southern Tasman Sea". Tropical cyclones produced highest waves. Mid-latitude cyclones over the southern Tasman Sea produced very low to low wave conditions, whereas they produce (i) the most frequently occurring and dominant moderate year round, and (ii) high wave conditons during winter, for central and southern NSW beaches.

Hervey Bay

The bay is partially sheltered from the open ocean by Fraser Island. The wave climate usually consists of a locally generated sea, and longer period externally generated swell, the two coming from different directions, and leading to bimodal spectra (Carter and Pattearson 1987). See Fig IV.6.

Brisbane

In 1988/89 the BPA recorded the highest waves since recording started in 1976. At 7 km north of Point Lookout on North Stradbroke Island maximum waves of 9.1 m were seen, with significant wave height of 6.1 m (BPA Annual Report 1989).

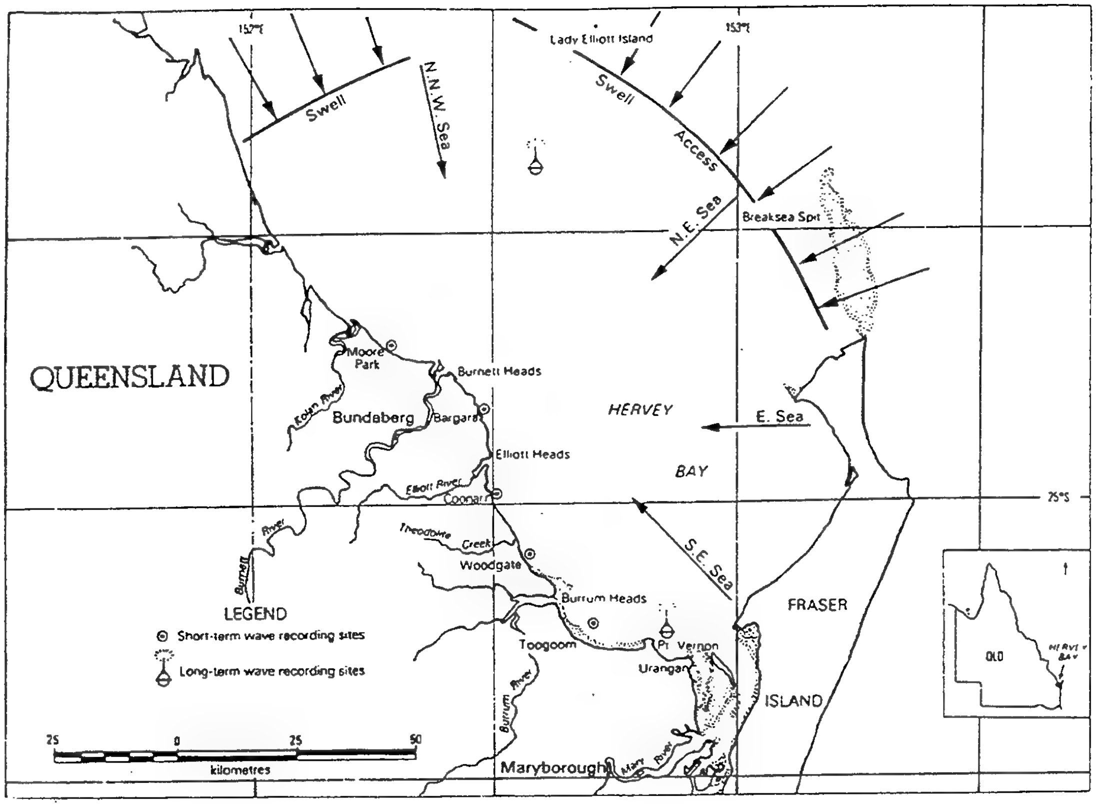


Fig IV.6. Wave directions in Hervey Bay (Carter and Pattearson 1987).

Moreton Bay

The constricted northern entrance to the bay is sheltered by Moreton Island from ocean generated swell. Waverider buoy data collected along the shipping channel between 1980-84 indicates the probability of exceedence of waves having a significant height of 1 m and a period of 9 s is less than 1%, and that the mean wave is only 30 cm in height and about 3 s in period (Lawson and Treloar 1985, quoted in Harris et al 1991). The available fetch in the bay ensures that the wind waves are of quite short period, and probably rarely exceed 2 m in height. Wind against tide effects can cause short, very steep-fronted seas (Mainstone and Fairman 1987). The wave climate in the bay is not extreme, with a maximum wave height of around 3 m in cyclone conditions (Crabb and Wilkinson 1981).

New South Wales

Thom et al (1973), and Kemp and Douglas (1981) describe general causes of waves for NSW waters, and show diagrammes of the corresponding weather charts. Also see The "Wind Waves Weather" series of the BOM for a similar presentation. Short and Trenaman (1992) describe the causes and climatology of waves at Sydney as follows. Waves are generated by five meteorological systems: tropical cyclones, east-coast cyclones, mid-latitude cyclones, zonal anti-cyclonic highs and local summer seabreezes (Fig IV.7). Each source has a characteristic seasonality, location and signature. February-March and June experience the largest average monthly wave heights. Moderate waves dominate the climate, but extreme waves (> 4 m) and/or low swell may occur in any month. Longest wave periods occur in winter. Waves most frequently arrive from the east for January-march and October-November and from the south-east for April-September and in December, with north-east waves being subdominant in all months but having a distinct summer maximum and winter minimum. Periods of 6-16 s and heights up to 10 m can occur. During spring months (October to December) the entire coast experiences a transitional "calm" period, when wave heights and periods are much lower than average (Harris et al 1991). See the description for the South-East coast for more details. Kemp and Douglas (1981) found that the combined maximum incidence of storm events progresses southwards along the coast from March in the north to June on the south coast. A June double storm peak was caused by the influence of both tropical and temperate weather systems. The central coast region experiences a slightly more severe wave height climate than the rest of the N.S.W. coast (Gordon 1987).

The wave climate at Newcastle, Botany Bay, and Jervis Bay offshore waveriders are very similar. Significant wave heights at these sites were rarely below 0.5 m, and almost never below 0.3 m i.e. dead calm wave conditions almost never occur along the central NSW coastline. Low long period swell makes an important contribution to the wave climate of the central NSW coastline (Lawson, McCowan and Treloar 1987).

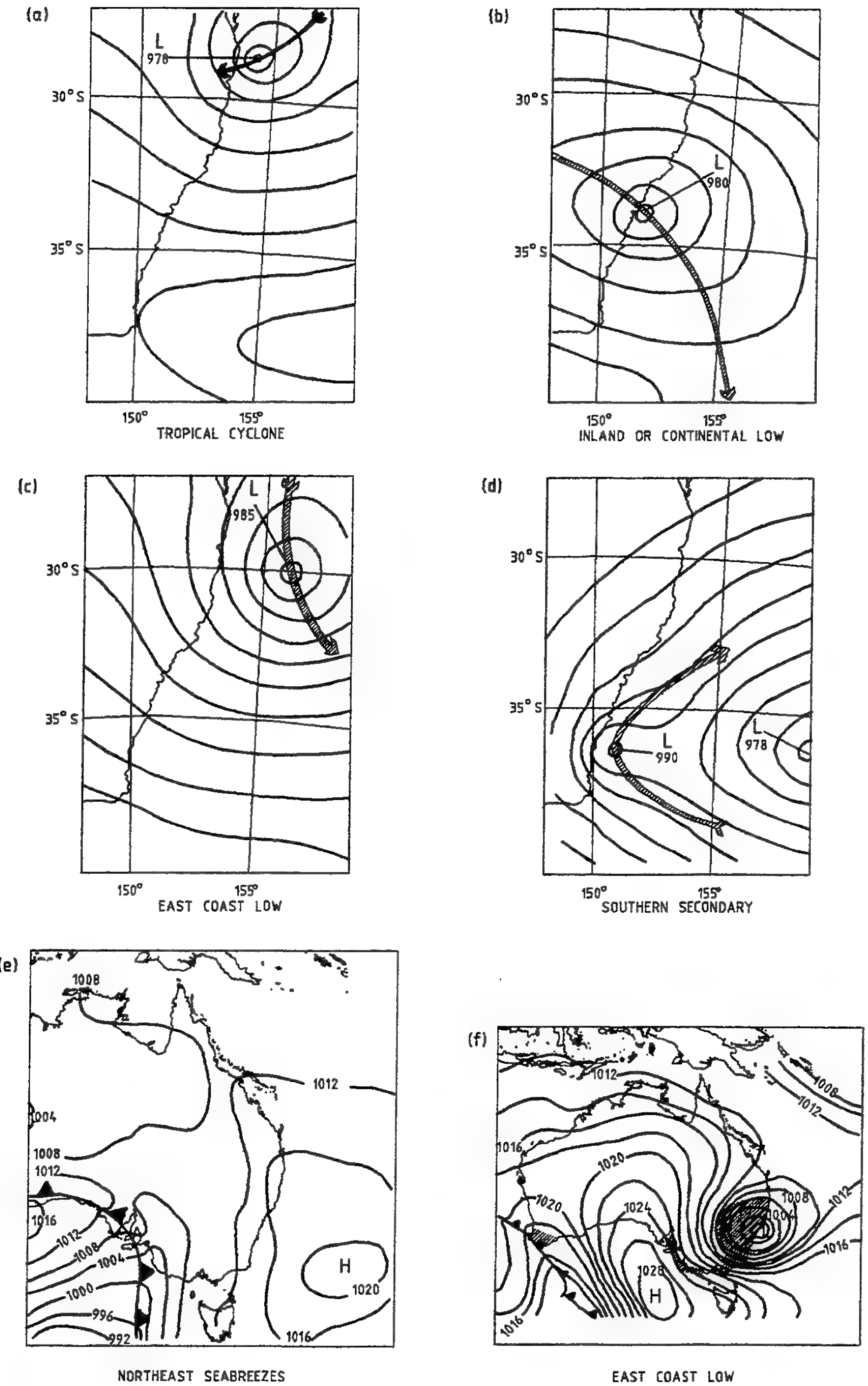


Fig IV.7. Wave producing weather systems of New South Wales (see e.g. the Wind Waves Weather series booklets of the BOM; and Kemp and Douglas 1981)

Tweed Heads

Surface waves are diffracted and refracted around and between the rock reefs. Due to attenuation, the maximum significant wave height measured at stations near Tweed heads was less than 2 m, compared with a simultaneously recorded deepwater value of 4.8 m at Cape Byron (Wyllie and Tomlinson 1989, quoted in Harris et al 1991). Peak storm waves approach the coast from a southeasterly direction, and are refracted and shadowed by by Cook Island and Danger Reef.

Port Stephens

Shallow areas cause wave focussing onto particular beaches. At Jimmys Beach the average significant swell wave height is about 0.3 m, and a 1 m significant swell wave height is exceeded about 1 percent of the time. Significant wind-wave height of 1 m is exceeded about 1 percent of the time (Wilson and Neilson 1987).

Newcastle

Dredge spoil removed from the harbour and dumped offshore built up over the years and influenced wave refraction patterns. This led to wave focussing and an increase in wave conditions at the harbour entrance, and erosion at the southern end of Newcastle Bight (Treloar and Abernethy 1977; Lord and Nielsen 1989; quoted in Harris et al 1991).

Swansea Channel (Lake Macquarie)

The channel is relatively free from wind generated waves (Brazier and Strachan 1978). Stone (1964) found ocean waves from the north-east to east had the most effect on the channel entrance, with periods 6-14 s and height up to 9 m. The maximum wave height able to cross the entrance bar without breaking was 2.4 m, leading to waves of 0.3-0.6 m in Salt's bay, and heights of 0.9-1.2 m farther west.

Broken Bay

For a current meter in 24 m at the entrance to Broken Bay, 55% of incident wave energy arrived from the ESE direction (NSW Govt 1989). Ettalong Beach (Broken Bay): "Due to refraction and diffraction, Ettalong is considerably more exposed to wave directions from the quadrant centred about SE than directions from the quadrant about NE. Because a greater percentage of offshore waves approach from the SE in winter than in summer the wave climate demonstrates a strong seasonal variation" (Ray and Hoffman 1978). Kulmar and Gordon (1987) show

the general deepwater wave refraction pattern in Pittwater, and discuss sediment transport due to swell and local wind-waves.

Bondi

The inner Sydney shelf is dominated by a moderate to high energy wind and swell wave climate. Bondi beach is sheltered from north of east, and exposed to the eastsoutheast to south sector (Clarke and Hardie 1988). Ebner and French (1985) found that large swells with periods of more than 12 s caused significant unsteady currents at the seabed as deep as 80 m.

Port Jackson (Sydney Harbour)

Oceanic swell waves are refracted through the Heads, but most of Port Jackson is affected only by locally derived wind- and ship-generated waves (Harris et al 1991). The width of Port Jackson is about 1500 m, which is large enough not to cause diffraction for periods less than 14 s (Podger and Youll 1985). Athol Bay is completely protected from open ocean swell, and hindcast maximum significant wave height is 0.5 m (Cowell and Kotvojs 1987).

Botany Bay

Oceanic swell penetrates into the bay. Dredging in the 1960s changed the wave refraction pattern in southern Botany Bay and led to erosion of the foreshore at Kurnell; the erosion was subsequently stabilised by the construction of rock groynes (Lord and Nielsen 1989, quoted in Harris et al 1991). Outside the bay for 1971 to 1993 the average monthly Hsig is about 1.53 m (August-September) to 1.67 m (February-March), with average mean monthly significant period 7.3 s (January) to 8.7 s (June) (from information supplied by Max Willoughby of MSB). Dredging for the third runway also changed refraction patterns, and some designing was done to control the new wave climate (SPCC 1979). The wave climate immediately south of the runway was bimodal, with short fetch wind-waves of periods up to 4 s, and ocean swell with periods over 7 s (Lawson and Atkinson 1978). Swell entering the entrance heads has a narrow range in direction from the southeast/northwest direction (Nielsen et al 1991).

Port Hacking

Refracted/diffracted swell of significant wave height up to 3 m may be experienced (Britton and Floyd 1985). Shallow waters mean that wave heights are dependent on tide level.

Port Kembla

Bosher (1977) provides wave refraction diagrammes for southeast and northeast waves. The shelf bathymetry includes rocky islands which act to reflect, refract and diffract waves into complex interference patterns. Southwell (1981) used design waves of 5.5 m and 10-14 s.

Jervis Bay

McCowan et al (1987) modelled the penetration of swell into Jervis Bay. At Green Point dominant direction of swell approach was 178-186 degrees from true north. Lawson and Treloar (1988) and Nelson (1991) describe bimodal spectra at Green

Point arising from residual swell penetration and local wind-waves. Three types of waves are found: ocean swell with periods typically 5-15 s; short period local wind waves of period under 5 s; long waves with low wave heights and periods typically 40-120 s originating from the Tasman Sea. The dominant weather events affecting Jervis Bay arive from the southeast. Fifty-four% of all offshore waves arrive from the south to southeast, 33% from the east, and 13% from north to northeast. Highest offshore waves are generally from the southeast. Long waves appeared to be directly related to the passage of ocean storms past Jervis Bay, with their height 1 to 1.5% of offshore swell Hsig generated by those storms (Nelson et al 1988). The bay seiches under strong southerly winds with period 34 minutes (Clarke 1971). There is a strong dependence between inshore significant long wave height and the significant height and period of offshore waves (Nelson and Lawson 1985).

Southeast Australian Coast (Victoria, southern New South Wales, and Tasmania)

The general atmospheric circulation in the region surrounding Tasmania and southeast Australia can be characterized as a steady procession of anticyclones (highs) moving from west to east with intervening troughs of low pressure. These troughs are usually accompanied by unsettled weather which often lasts for several days. Low pressure systems track eastward across the southern Indian Ocean, south of 50°S. Cold or occluded fronts associated with these systems usually extend northwestward from the storm center and track rapidly eastward through the Bass Strait region. Secondary low centers often form along these trailing fronts and move eastward or southeastward toward New Zealand. There are two favoured areas for the formation of the secondary low centers: (1) Great Australian Bight, and (2) western Tasman Sea. On rare occasions one of these low centers will intensify enough to generate very strong wind (> 50 knots) in the Bass Strait. These extreme wind/wave events can be classified in one of three categories: (1) southwest storms, (2) southeast storms, and (3) southeast/southwest storms." (Silbert et al 1980).

The wind seas are generated by predominantly south-west winds, and winds from the north-east to south-east. Extreme wave conditions are likely to be associated with "East Coast Lows". These intense, low pressure systems form along the east coast of Australia and result in very strong east to south-east winds that can generate significant wave heights of up to about 10 m. The corresponding individual wave maximum height would be about 18-20 m (Black et al 1994, p266 quoting Colman et al 1991).

From Short (1978): "The dominant southerly swell arriving on the south-east coast is generated by low pressure cyclones passing generally south of the Australian continent. The south coast is oriented perpendicular to the southwest swell and receives high wave power through the year, with a winter maximum. The east coast is oriented such that the southwest swell runs up the coast and arrives at the coast as a refracted southeast swell somewhat decreased in power.

During summer, tropical cyclones and lows or depressions off the east coast contribute high wave power, while north-east sea breezes generate persistent moderate power waves throughout. The cumulative deepwater wave power along the east coast is therefore considerable (Wright 1976) though less than the south coast. It is characterised by a summer (November to March) maximum in wave height arriving from all quadrants and a slightly lower though more variable winter wave height, arriving predominately from the southeast (Lawson and Abernethy 1975)".

Eastern Beach, Gippsland Coast, eastern Bass Strait

Wright et al (1982): The coastal wave regime is controlled by four factors. The prevailing westerlies blow generally offshore to the south of Lakes Entrance and alongshore to the east, whereas the southwesterly winds produce obliquely incident waves. Second, fetch lengths from the west and south increase eastward. Third, Wilsons Promontory and offshore islands north of Tasmania partially, but not wholly reduce the westerly and southwesterly swell reaching eastern Bass Strait. Finally the wide low-gradient continental shelf fronting the coast reduces the heights of larger waves before they reach the surf zone. The wave climate is thus strongly influenced by locally generated wind waves related to the passage of cyclones and gales. Hindcasting indicated that the average interval separating the occurrence of deep water waves of 2 m or more is a little less than 3 days.

Port Phillip Bay

Waves in the bay are mainly generated by local winds, which are predominately from the south and southwest for October to March, and from the west to north from April to September. Bass Strait swell impinges at the bay entrance from a restricted range between 193-232°True, but significant swells do not occur in the bay (BOM 1966). Significant wave heights are unlikely to exceed 2.5 m (Bureau Of Meteorology and ESPPB 1973, quoted in Harris et al 1991). Black and Mourtikas (1992): Time for full arousal in fetch limited Port Phillip Bay is typically 1-3 hours. Waves of 3-5 s period are common and these take 1-3 hours to travel across the largest fetches.

Portland

Portland harbour is protected from southwesterly winds and Southern Ocean swell by a basaltic peninsula (Harris et al 1991).

Bass Strait

Waves in Bass Strait are described as coming from two main sources: influences from the west, and lows off the New South Wales coastline. Western Bass Strait experiences southwesterly swell, and eastern Bass Strait experiences southerly swell. Ocean swell from the southwest appears related to the presence of intense low pressure systems well to the south of Tasmania around latitude 50° south (Gaggin et al 1987). Because of wind funnelling and shallow depths, this area has a reputation as one of the roughest areas in the world, experiencing similar conditions to Cook Strait in New Zealand. More detailed information is provide by Wright et al (1982). Near Gabo Island they calculated that deepwater waves exceed 1 m for 40% of the time, 2 m for 20%, and 5 m for 2% of the time. Average (rms) wave conditions are 1.5 m with 10 s period. For western Bass Strait average wave conditions are 1.6 m and 8.5 s. They show directions observed from the lighthouse at Gabo Island as 30% from the south, and about 16% for other sectors from southwest anti-clockwise to northeast. Seastate and swell direction recorded twice daily from Gabo Island for 1965-69 are shown by Reinson (1977). Spillane et al (1972) found peaks in wave activity in November and May, with the stormiest month in June.

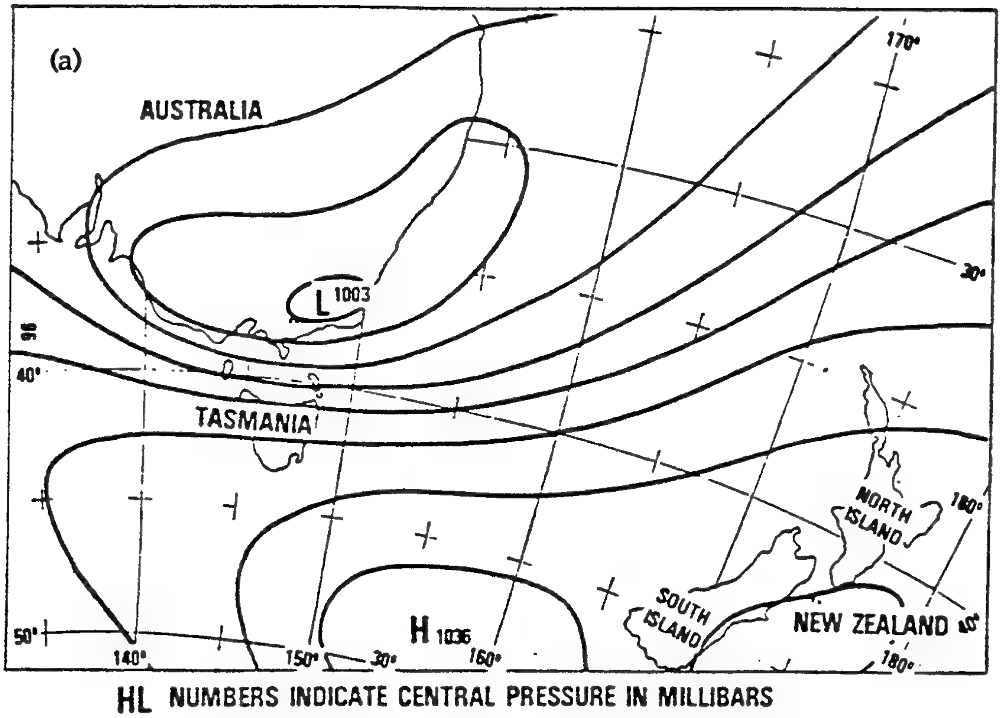
Long period swell entering the strait from both east and west is strongly attenuated. As a result of refraction and the blocking effect of King Island, coastal sites in the strait to the west of Wilsons Promontory exhibit a distinctive and often narrow window to the Southern Ocean from the western direction (Blackman 19--). According to Blackman and McCowan (19--) the depth of the strait means that waves of period 10 s or more will interact with the bottom, causing rapid dissipation of swell. Westerly swell is of little significance in eastern Bass Strait. Bottom interaction limits the development of local wind-sea and causes it to steepen, a quite notorious feature of the area.

Heideman and Padman (1985): At Kingfish B and Barracouta platforms in eastern Bass Strait severe conditions may be expected from three sectors, E/SE, S/SW, and West. Storms that produce large seastates forom E/SE have a different nature from storms producing large seastates in the S/SW and West. E/SE storms are characterised by a low that moves southward along the east coast of Australia into the Tasman Sea and combines with a pronounced high south of the Tasman Sea to produce high easterly winds of great fetch and duration over the Tasman Sea. S/SW and W storms are characterised by intense lows that track eastward along the south coast of Australia (Fig IV.8). Local SW winds are almost always associated with southwest waves; however local W winds are as likely to be associated with SW waves as W waves.

Currie (King Island)

Gaggin et al (1987): Currie harbour faces due west to the severe wave climate of the Southern Ocean, but is protected by rocky outcrops and extensive inshore

reefs. Significant penetration of swell occurs, and long period (surge) oscillations of period 12 minutes are also experienced, thought to be caused by low pressure weather systems crossing the Great Australian Bight along the continental shelf.



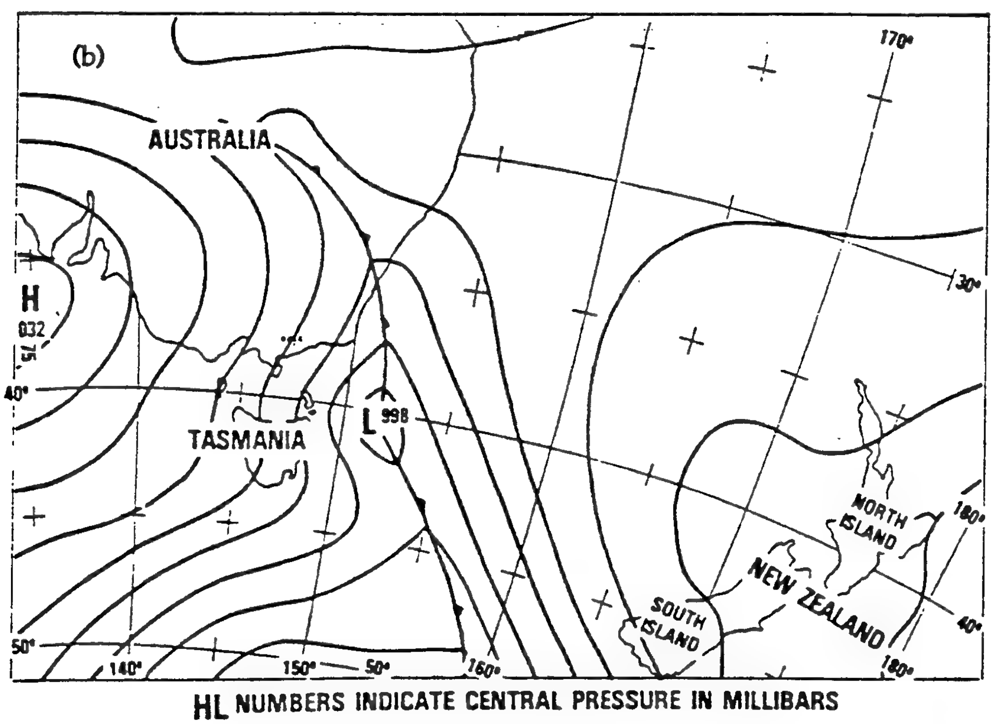


Fig IV.8. Wave producing weather systems of eastern Bass Strait (Heideman and Padman 1985). (a) Typical East/Southeast storm. (b) Typical Southwest storm.

Tasmania

For Cape Grim and Cape Sorell, Reid and Fandry (1994) recorded a maximum upcrossing wave height of 19.8 m, and a maximum downcrossing wave height of 17 m. Heights at Storm Bay were about half those on the west coast. At Cape Sorell the average significant wave height was 3.4 m from July to October, and 2.9 m for summer to autumn. Monthly means of spectral peak period at Cape Sorell, Cape Grim and Storm Bay were 12-13 s. Storm Bay generally showed longer periods for May to September. Underwood (1987) computed wave power around Tasmania from lighthouse and oil rig observations. Note that Bass Strait is discussed in the previous section.

Burnie

Burnie Port Authority (personal communication): Short, steep waves get up very quickly in the harbour, and go down quickly also. Swell up to 2 m is experienced. Waves were measured from January 1983 to August 1985 for siltation and wave climate studies by Lawson and Treloar, but information is not available for this report.

Port Latta

Port Latta (5 nautical miles southeast of Stanley) on the northern coast of Tasmania has experienced waves in excess of 10 m (Harris et al 1991).

Port Macquarie (west coast near Cape Sorell)

Heavy southwesterly swells can refract round Cape Sorell and enter Port Macquarie, causing wave conditions described as severe. Surging of 2 foot amplitude and 15-20 minutes period is experienced. Seiching was studied by Monash University but no publications are known. (Pickands Mather 1965; Waterman and Matthews 1979).

Great Australian Bight

The wave climate is dominated by energetic Southern Ocean swell with typical periods of 15 s (Young and Gorman 1995). Typical wave height in the Southern Ocean is often greater than 5 m. Provis and Steedman (1985) measured a height of 10 m on the shelf. The coast is exposed to persistent southwestern swell with a fetch across the Southern Ocean. The season with the greater wave energy is generally from March to October, while November to February is relatively less energetic, although calm water is rare (Harris et al 1991). In the vicinity of

Kangaroo Island the southwest to southerly swell is 2-4 m for 30-45% of the year (Short and Fotheringham 1986). A southerly summer breeze can produce waves up to 1.5 m which augment the lower energy summer waves (Short 1985). [This information is mostly from Harris et al 1991].

Culver and Walker (19--) provide wave atlases for several sites of monthly persistence and exceedence curves for Hsig, and joint scatter plots of height and period. Details of the most severe conditions recorded, including storm wave energy spectra are shown. Sites and most severe conditions are as follows: Port Macdonnell (sheltered location 1 m, 4-5 s), Penneshaw (1.8 m, 5.2 s), Seacliff (2.5 m, 5.5 s), Redcliff (sheltered, no significant storms), Cape Jervis (sheltered location 1.3 m, 2 s), and Port Giles (1.3 m, 4 s). Measurements were also taken at Tickera and Wallaroo. Very long period energy occurred at Cape Jervis (period of two minutes and higher).

Adelaide - Gulf Of St. Vincent

The Adelaide area is protected from more frequent severe sea conditions by the configuration of the gulf and the shallowness of the water. Severe storms do occur on several occasions during the year resulting primarily from winds of varying duration in the quarter from SW to NW (Chappell 1983).

Byrne, Wynne and Thomas (1983); Kinhill Stearns and Riedel and Byrne (1983): Long period swell waves are insignificant at Adelaide. Both the narrow entrance to the Gulf and the shallow waters result in almost total attenuation. Locally generated waves provide the largest waves in the gulf (during storms) and provide the dominant southerly to south-westerly waves. Maximum wave periods are in the range 5-7 s. During two years of wave recording the maximum wave height was approximately 2.5 m. The estimated extreme significant wave height is 3 m. As a depression moves past to the south of Adelaide, winds change to westerlies and then to south westerlies. The fetch is greater from the southwest, and the maximum waves, generated from this direction, often occur at the height of the storm surge.

Spencer Gulf

Because of the shape of the coastline, Spencer Gulf is protected from the effects of ocean waves and swell from all directions except the south to south west. "The season with the greater wave energy is generally from March to October, while November to February is relatively less energetic, although calm water is rare. The two gulfs are protected from the Southern Ocean swell by islands in their entrances. The large size of the gulfs, however, allows 1.5 m waves to be generated locally" (Harris et al 1991). "Wave heights were recorded during 1965 by the Department of Marine and Harbours at Port Neill in the Lower Gulf. .... The height of the swell recorded was very small, of the order of centimetres" (Noye 1984).

Although Spencer Gulf has sufficient wind fetch to allow the generation of significant wind waves, it is insufficient for the generation of long wave swell. Ocean swell enters the Gulf from the south or southwest but suffers significant attenuation due to the passage through shallow water and the obstruction of the coastline. Most waves should therefore be generated by local winds.

Winds are often from the south west, perhaps accentuated by funnelling along the gulf. "From an analysis of wind data recorded at Adelaide airport it was found that the wind was from an arc of 45^{o} centred on south west for 25% of the time". This direction leads to maximum fetch along the gulf. Time scale of variations in weather conditions is of the order of 2 days (Tronson 1974). "South west winds are more frequent and stronger than other winds and are usually associated with weather conditions which may persist for up to 3 days. These winds generate considerable wave activity. In the <u>shallow</u> waters of the gulf, the waves increase the turbulent motion on the sea floor, enabling the bottom sediment to be more easily moved. .....the bottom sediment distribution partly reflects the circulation driven by south west winds".

South West Australia

As for the southeast Australian coast and the Great Australian Bight, this area is influenced by the passage of highs from west to east along 30°S, and swell generated by Southern Ocean lows south of 50°S. South of about 30°S the coast receives the full effects of the swell, but north of this the orientation of the coast protects the northwest shelf coastal areas from the south and southwest swell. Some of the coastline is sheltered from the direct effects of swell by an extensive chain of offshore reefs, and waveheights may be decreased by 40% (R.K. Steedman quoted in Pattiaratchi et al 1993). Collins (1988) shows winter (April to September) swell on Rottnest Shelf (from Fremantle to Bunbury) mostly coming from southwest to west; and summer (October to March) swell mostly coming from south to southwest. Waverider data obtained over a six year period indicated significant wave heights of 1.5 m with 14 s peak period. Swell periods range from 10-20 s, and during storms wave heights of 6 to 7 m are common. Waves are refracted by 5-15° as they cross outer shelf ridges. Sea breezes in south-western Australia frequently exceed 15 ms^{-1}, with a mean of 7 ms^{-1}, affecting the local wave climate on a daily basis (Pattiaratchi et al 1993).

Bandy Creek, Esperance Bay

Swell arrives at Bandy Creek, Esperance Bay in a narrow band from between 170-181° (Boreham 1991).

Esperance

Lewis et al (1990): Two bands of dominant wave energy were found in Esperance harbour. These were 15-25 s swell and very long periods greater than 40 s. At Berth 1 ship motions were caused by the swell penetration, while at Berth 2 ship motions were caused by the very long wave oscillations amplified as standing waves in the harbour basin.

Geographe Bay

Refracted swell from the southwest maintains an eastward littoral transport around the bay, which is interrupted by relatively infrequent north-west gales of short duration. Geographe Bay Road has been attacked by a combination of storm surge and waves generated by strong north-west winds (Paul and Searle 1978).

Cockburn Sound

Riedel and Trajer (1978) measured offshore extreme Hsig of 5.1 m and maximum wave of 8.5 m from offshore data for 1970-76. The offshore wave climate was described as mild with an average Hsig of 1.5 m, with little variation from year to year for summer-autumn, and a more severe and variable wave climate in winter. In the vicinity of the eastern shores of Garden Island locally generated waves are small, seldom exceeding 0.1 m, and local sea conditions are more important than swell (Treloar et al 1989). Summer seabreezes blowing from south and southwest interact with persistent swell arriving around Garden Island from the NW direction (Silvester and Searle 1981).

Nelson and Wilkinson (1986) investigated "heavy surging and rolling" experienced by vessels at HMAS Stirling jetty on the northeast of Garden Island. Residual swell approached the Stirling jetty from between northeast and east of northeast. Long period wave energy was present in the sound most of the time, with maximum measured height for a single wave train of 100 mm, and periods from 80-200 s, and dominant wave period 110-130 s. It was concluded that the ship motions were due to penetration of residual swell, not long period wave activity. The residual swells were very flat waves with heights between 0.15-0.3 m, and a wavelength of about 150 m in water depth 12 m.

Wave motions with periods of about 30 minutes have been reported for offshore locations (mentioned by Beer 1983).

Perth Area

Pattiaratchi, Hegge, Gould and Eliot (1993) investigated the effects of the seabreeze system at South Scarborough Beach, Perth. The nearshore environment responded dramatically to the onset of a sea-breeze of mean speed of 7 ms^{-1} and up to 15 ms^{-1}, with the development of a wind-wave field of 3-5 s period, and increase of wind-wave heights from 0.5 to 0.7 m, with an increase also in ambient swell heights. Mean longshore currents and erosion increased. Wind-wave period increased from 2 to 5 s in less than 2 hours, and changes in wave direction were also observed.

Geraldton

Swell mainly approaches the channel area from about 240° and wind-waves from about 190°. Waves of up to 7 m have been observed in the channel during winter (Geraldton Pilots and harbourmaster observations).

Houtman Abrolhos Shelf

An average wave impacting on the Abrolhos shelf (approaching from the south-southwest) is 1-3 m in height and has a period of 10 s. Under extreme conditions, such as during winter gales, typical surface waves 7 m in height and 13 s in period could be experienced, with maximum heights of 14 m (France 1985, quoted in Harris et al 1991). Persistent swells impinge on the Abrolhos all year, approaching from the south during the summer months, swinging towards the southwest and becoming more variable during autumn and winter. Persistent swell waves with a mean height of 1.2 m impinge on the Abrolhos throughout the year, approaching from the south and west 78% of the time (Steedman 1977).

Shark Bay

Johnson (1974): The prevailing southwesterly winds generate the most persistent wave fields in Shark Bay. A short, sharp sea results from the sea breezes and this is more or less a daily feature. The waves are of a very irregular form, approximately 1 to 2 m high, 5 to 15 m long with periods 2-4 s. When southerlies blow for several days, a south to southwesterly sea is generated over the relatively long fetch distances of 50 to 60 km upwind from the delta. Calculations by Logan and Cebulski indicate this sea should have average height of 1.3 m, a length of 150 m, period 4 s, and speed of 6 m/sec. Northwesterly storms produce both sea and swell. The swell can last in a small form for several weeks but the seas are quickly reversed when the winds drop and the southerlies are re-established. Waves generated by northerly gales can have profound efects though their limited duration prevents the formation of features comparable to those due to the southerlies.

North West Shelf

The coastal orientation coupled with the very wide continental shelf allows only greatly reduced swell from the south and southwest to reach the northwest shelf coastal areas by refraction. In the north of this area the sea and swell are generated by local winds (including sea-breezes), the Southeast Trades, storms, cyclones, and monsoon systems. Buchan and Stroud (1993) classify the sources of waves and swell on the Northwest Shelf as follows: Southern Ocean swell, summer monsoonal swell, winter easterly swell, tropical cyclone swell, and local wind-generated sea. As a result of the northward migration of winter highs, swell heights increase in July, but highest waves are generated during tropical summer cyclones. Outside the cyclone season conditions are generally calm and the wave heights in near coastal areas are generally small, with long periods of significant height under 1 m, with most waves over 0.5 m generated by local winds. Waves and swell in the coastal areas of Dampier and Port Hedland occur in three particular frequency bands: long period swell (12-20 s), cyclonic waves and swell (8-12 s), and local waves (2-8 s). Each frequency band tends to have a particular spectral shape, which can be approximately characterised by the Ochi and Hubble (1976) spectral formulations (Hamilton 1997). Hamilton found that particular weather patterns could be correlated with particular wave frequencies for the Dampier and Port Hedland areas (Fig IV.9). For examples of meteorological and oceanographic information on the North West Shelf and Timor Sea, the reader is referred to Buchan and Stroud (1993).

Timor Sea

Buchan and Stroud (1993). Perennial swell approaches from southwest from Southern Ocean storms. Wind waves are generated by summer westerlies and winter easterlies (April to September/October), with periods 2-7 s. Transient variations are caused by storms.

Exmouth Plateau

Buchan and Stroud (1993). Perennial swell approaches from south and southwest (170-220°) for 70-90% of the time from the Southern Ocean depressions. Significant swell height should usually be 1-2 m, but may be up to 4-5 m. Lesser swell may approach from the east in winter. Nine seconds is the normal separation point for sea and swell. Swell from tropical summer cyclones could reach 8-11 m significant height. Southerly swell can have periods 9-20 s, and easterly storms and tropical cyclones have periods 6-9 s.

Exmouth Gulf

Steedman (1987): two important storm populations are quoted as gradient intensifications and tropical cyclones. Modelling indicated that the maximum wind leads the maximum wave by 1 to 3 hours, and the maximum wave leads the storm surge height by 1 to 4 hours. Maximum significant wave heights of up to 3 m were predicted, with significant period 5-6 s.

Griffin (Steedman Science & Engineering 1992, quoted in Black et al 1994)

Using wave hindcasting from wind data the following estimates were made. Approximately 73% of the total significant wave height did not exceed 2 m. Approximately 98% of the total wave height had zero crossing periods less than 10 s. The largest significant wave height calculated over the hind cast period (not quoted in Black et al) was 5.3 m. The larger waves were persistent during June to August. The seastate is a combination of sea and swell.

Port Hedland

Ocean swell approaches from the northwest and has a significant wave height less than 1.5 m for 70-90% of the time (Harris et al 1991). The northwest approach direction is caused by refraction of southwesterly swell (Buchan and Stroud 1993). Rice (1987) inferred maximum wave heights of 5.4 m from pressure data recorded during Cyclone Chloe in 1984, and a storm surge of 1.25 m was measured in the harbour.

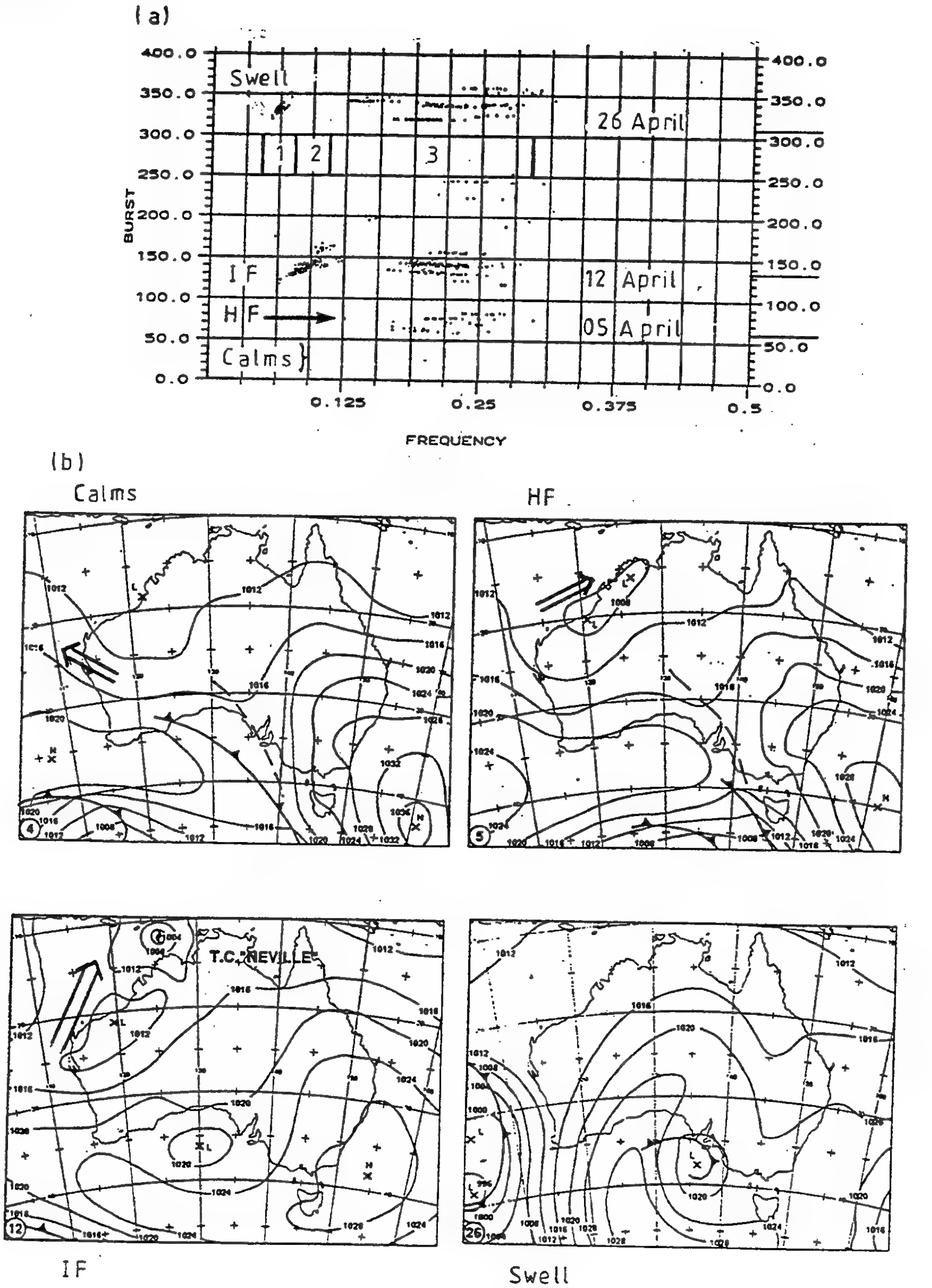


Fig IV.9. Wave producing weather systems of North Western Australia (Hamilton 1997)
(a) time series of power spectral densities April 1992. Waves occur independently in three frequency bands: 1 = long period swell (12-20 s); 2 = IF (8-12 s); 3 = HF (2-8 s).
(b) BOM weather charts. Day is circled on lower left. April 4=east winds: calms. April 5=elongated low parallel to the coast: HF April 12=tropical cyclone: energetic IF. April 26=front to southwest with low: long period swell.

Dampier

Long period swell from north, north-west and west impinges mainly on the exposed portions of the outer islands. Southerly facing coasts, embayments, straits and passages are protected from swell. Waves were mostly generated by local winds and were generally less than 1.3 m in height (Semeniuk et al 1982). In winter waves were mainly from north-east, east, south-east and north-west, and in summer mainly from south-west, north-west and south-east.

In Mermaid Sound the predominant windwaves come from north-north-east, and swell is refracted to come from a north-north-westerly direction, leading to a bimodal wave climate (Buchan 1985).

North Rankin A

Low waves of long period (12-20 s) are occasionally experienced (Buchan and Stroud 1993; Lawson, Rice and Szylkarski 1994). A waverider recorded a significant wave height of 10.5 m before it failed during tropical cyclone Orson.

Derby (King Sound)

Surface waves cause little sediment transport, due to limited fetch (Harris et al p169).

Northern Australia

The northern areas of Australia generally have moderate to low wave climates except during tropical cyclones when large storm waves may be superimposed on storm surges several metres in height (Bremner et al 1980). For conditions in the Gove area see the discussion for the Gulf of Carpentaria in the Queensland section.

Darwin

Port Darwin is protected, and the wave climate is low, with little penetration of long period swell (Scott 1985). Waves are typically less than 0.5 m with periods 2-5 s. The majority of waves are locally generated in the harbour or in Beagle Gulf. Design cyclones are predicted to cause 3-3.5 m waves (Byrne 1987). Maximum recorded wave heights in the harbour have been about 1.5 m (Scott 1985). For general remarks on the Gulf of Carpentaria area, see the Queensland section.

Papua New Guinea and Bismarck Sea

Morgan (1972) shows a map of 16 coastal sites around Papua New Guinea and the Solomon Islands, for which he inferred seasonal seastate histogrammes from wind speeds. Seastates mostly averaged 2, but only simple methods were used, and some locations may not have been representative of open ocean conditions.

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19. ABSTRACT

Operational sites providing near real-time wind-wave and swell measurements are listed for the coastal waters of Australia, as at February 1996. A representative listing of historical data sites is also provided, with a comprehensive bibliography of papers and reports on wave investigations. An introduction to wave conditions around Australia is included. Real-time high resolution digital data are available from moored wave-rider buoys, mostly non-directional, and from fixed platforms used by the oil and gas industry. A coastal radar provide directional wave spectra in Gulf St. Vincent. Lower resolution near real-time data are available from satellite altimetry and synthetic aperture radar systems, but not usually within about 80 km of the coast. The JINDALEE over the horizon radar experimental array covers the northwest seas of Australia, and is planned to be expanded to cover the area from Geraldton to Cairns. Spot visual observations of sea conditions are made for beach watch and surf reports, from fixed positions such as lighthouses and oil platforms, and from transiting vessels. The Bureau Of Meteorology runs a Wide Area Model (WAM) for deepwater wave prediction, using satellite and ship observations as inputs.